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the twenty-first
oilseed processing clinic.
Held at New Orleans, Louisiana,
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FOREWORD

The Oilseed Processing Clinic is sponsored jointly by the Southern Marketing and Nutrition Research Division and the Mississippi Valley Oilseed Processors Association, Inc.

The presentations at this Clinic reported practical information that will benefit the oilseed processors in their plant operations and enhance the consumption of oilseeds. Informative topics related to the theme of the meeting, "Changing Times for Oilseed Processing," were included for discussion.

These proceedings report the statements presented by the various speakers during the 1972 Clinic.

C. H. FISHER, Director
Southern Marketing and Nutrition
Research Division

ACKNOWLEDGMENT

We are proud and honored to have been associated with Roy B. Davis, an outstanding industry leader, for his pioneering leadership and untiring devotion to promoting the prosperity of all those engaged in the production, processing, and utilization of cotton.

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PROCEEDINGS OF THE TWENTY-FIRST OILSEED PROCESSING
CLINIC HELD AT NEW ORLEANS, LA., FEBRUARY 7 and 8, 1972

WELCOME

by
C.H. Fisher, Director
Southern Marketing and Nutrition Research Division
New Orleans, La.

On behalf of the Southern Marketing and Nutrition Research Division (SMNRD), I welcome you to the 21st Oilseed Processing Clinic. I hope you will find this meeting so rewarding that you will return to our future clinics.

I welcome you also on behalf of Talcott W. Edminster, Administrator of the Agricultural Research Service. We are pleased that Fred R. Senti, Deputy Administrator of ARS, is here to extend his own welcome.

We in the Southern Regional Research Laboratory (SRRL) continue to be grateful for the privilege of sponsoring these clinics in cooperation with the Mississippi Valley Oilseed Processors' Association. We appreciate the opportunity of working with you for the benefit of agriculture and those who produce, process, and consume agricultural products.

Last year I called your attention to the fact that our Division's name had been changed — what was formerly the Southern Utilization Research and Development Division became the Southern Marketing and Nutrition Research Division. Although nothing this dramatic has happened recently, there have been several changes and events worthy of mention.

We now have a more flexible patent and licensing policy. As before, nonexclusive licenses may be granted for the practice of our inventions. Under some conditions, exclusive licenses may be granted. For the last several years, about 50 patents per year have been granted to inventors of SMNRD.

Two laboratories formerly associated with SMNRD have been made a part of our sister division, Southeastern Marketing and Nutrition Research Division, which is headquartered at Athens, Ga. One is the Fruit and Vegetable Products Laboratory, Winter Haven, Fla., and the other is the Food Fermentation Laboratory, which works in close cooperation with the North Carolina State University and Agricultural Experiment Station, Raleigh, N.C.

The Textiles and Clothing (T&C) Laboratory, Knoxville, Tenn., has been made a part of SMNRD. We are fortunate because Mary E. Carter, a distinguished textile scientist, joined our Division as Chief of the T&C Laboratory. The T&C Laboratory is located on the campus of the University of Tennessee and we are grateful for the privilege of working in cooperation with the University of Tennessee, particularly its Department of Home Economics.

During the past year, our research, conducted in cooperation with industrial associations and other organizations, has continued to be profitable. Some of our research findings have been adopted by other organizations and used for practical purposes, and some of our developments that were previously commercialized are being used more extensively.

Our scientists and engineers, working cooperatively with other organizations, have contributed importantly to 15 commercialized developments during the past year. The developments with cottonseed and cotton lint may be of particular interest to the oilseed industry.

The Liquid Cyclone Process pilot plant at Sundatta Oil Mill, Hubli, India (Dorr-Oliver, Inc.) is producing an edible cottonseed flour concentrate and its capacity will be increased from one to five tons per day. A Liquid Cyclone Process plant for producing 25 tons of high quality protein flour from glanded cottonseed is under construction at Plains Cooperative Oil Mill, Lubbock, Tex. The plant is scheduled to begin production in 1972. Roy Davis, former manager of Plains Cooperative, played a major role in the Lubbock development. We are grateful to him and pleased because he is attending this conference.

The Millicolumn method for detecting and measuring aflatoxins in cottonseed and peanuts in about 15 minutes is being used with both dollar and health benefits.

New chemicals, featuring advantageous "leaving groups," are being used commercially to make durable-press textile products.

The Zirchrome Process for producing sunlight and rot-resistant fabrics for outdoor use has been licensed by four companies.

A major firm has requested and been issued a license to practice the invention under U.S. Patent 3,416,880 entitled "Modification of Cellulosic Textiles with Methylolated Hydroxy-alkyl Carbamates."

Although a number of flame-retardant formulations containing tetrakis(hydroxymethyl)phosphonium chloride (THPC) are used commercially, two new products are now offered by American Cyanamid, their first entry into the THPC area. One of the products, TKC, is a 60 percent solution of THPC. The other product is tris(hydroxymethyl)phosphine (THP), adduct of THPC and urea.

The SRRL Fiber Retriever, Model M-2, is being used commercially. This is the first commercial application of the M-2 device, which

provided maximum cleaning at slightly increased cost as compared with the simple M-1 model. The M-1 Retriever is installed on an estimated 18,000 carding machines.

The SRRL Bale-Opener-Blender Patents No. 3,166,797 and No. 3,458,904 have been licensed to a large corporation that plans to manufacture the Blender for company-wide use.

Advances in the measurement and effect of fiber hooks and fiber orientation on textile processing efficiency and product-quality have been commercialized.

The 3/2 twill construction fabric developed for durable-press work trousers is available from Sears Roebuck and Co., and Woolco Department Stores.

Improved, all-cotton knitting yarns from blends of 1 1/16-inch cotton have been produced by standard processing organizations under close laboratory control. One of the country's largest knitwear manufacturers has advised that the yarns are superior to their own which are produced from higher quality, more expensive cotton, and hence, are of practical interest to the industry.

Citrus World, Inc., Lake Wales, Fla., (a cooperative) is manufacturing orange juice solids or crystals. They are reported to be packing more than 555,000 15 1/2-oz. cans of crystals for the Department of Defense, with plans to begin packaging for the retail trade soon. The process is based on cooperative research by our sister Western Marketing and Nutrition Research Division, our former Fruit and Vegetable Products Laboratory, Winter Haven, Fla., and the Florida State Department of Citrus. Although you didn't learn this from TV programs, orange juice crystals were aboard our Apollo flights 12, 14, and 15.

Progress in our research in fiscal year 1971 was reported in 271 technical papers, 211 presentations to scientific and industrial groups,

and 39 patent applications. Twenty patent licenses were granted. Five honor awards were received by our scientists.

We are fortunate in that we have acquired valuable instruments and pilot-plant equipment that are being used effectively to do research of major importance to oilseed products. In this research, emphasis is being given to the development and evaluation of attractive protein isolates, concentrates, and flours from cottonseed and peanuts. Some emphasis is being given also to acquiring basic information on composition and mechanisms that should be helpful in improving the quality and storage life of oilseeds.

Pilot plants for making protein isolates and protein concentrates by either dry or wet processing methods are nearly complete.

We are indebted in part to our friends in industrial and other organizations for any successes we have had. A considerable portion of our cooperative research on cottonseed and linters is supported by funds from the National Cottonseed Products Association, National Cotton Batting Institute, and Cotton Incorporated. We are grateful for this support and encouragement.

We are grateful also to many individuals in industry, including: Garlon A. Harper, Harold Wilcke, Keith Smith, Richard Phelps, and Hal Lewis. Fred R. Senti, our Deputy Administrator in Washington, receives our appreciation because of his special interest and contributions.

I do not know of anyone who has worked more effectively with as much dedication for the oilseed industry than Roy B. Davis.

I hope that your stay in New Orleans will be enjoyable and rewarding. Please visit our Laboratory and talk with our scientists and engineers, if you have an opportunity. We cordially invite you to visit us individually or as groups during the year.

CHANGING TIMES FOR OILSEED PROCESSING

by

Roy B. Davis, Retired
Plains Cooperative Oil Mill
Lubbock, Tex.

It has been said that the only thing which is constant is change. Certainly this is true with the oil milling business. While change is ever present, it brings problems and opportunities which are very important, and I believe it is highly appropriate as the theme of this conference.

A century ago, the cottonseed crushing industry was an infant with about 80,000 tons of seed being processed. Cottonseed became the "giant" of oilseeds by the turn of the century, and more than 6 million tons were processed in

each of the years 1926, 1937, and 1953. By 1953 soybeans had surpassed cottonseed in volume.

In my attempt to keynote this conference on changing times for oilseed processing, I shall be satisfied if I can impress upon you that more important than change itself is how we react to change and whether we use our opportunities to stimulate changes which will benefit our companies and our industry.

In 1959, the industry's good friend, the late

Cecil Wamble, published an article entitled, "How Cotton Oil Mills Are Changing." After reviewing developments of that time, he concluded that cottonseed products enjoyed few, if any, exclusive privileges in the market place and said, "If there is anything left about the industry that is exclusive, it is probably the men who have guided its destiny through the years." Upon occasion we have failed to measure up to the faith which Cecil had in us. Nevertheless, today I have that same conviction of confidence in the industry which Cecil expressed 12 years ago.

Cotton and cottonseed are great crops which have been good to us and to the communities where they have been grown and processed. We are strong on cotton — past, present, and future — and we like to keep reminding people that if it is cotton-related, it is good for the area and all its residents. We believe that cotton and cottonseed are uniquely good and that the men who engage in and lead the industry have the vision, capability, and courage to achieve those objectives which are needed. If I were not optimistic about the future of cotton fiber and seed, I would not be talking to you today. To paraphrase Shakespeare, I come not to bury cotton but to tell you that its greatest glory is in the future.

I do not have to tell you here today that anyone who stays in the oilseed crushing business has to be a realistic, hard nosed businessman. I believe it is realistic to welcome change, as a whole, because the path we travel leads either up or down, and it is largely our decision which way we travel.

An adequate volume of seed to process is the problem of most concern to our mills. This really is not change because this industry has always had surplus crushing capacity. The real change is that it is simply more acute now, and it is essential that we bring about some changes to increase available volume of raw materials to crush.

Soybeans have continued to increase in volume in the established production areas, and we are making some progress in areas where they have been marginal in the past.

We became accustomed and somewhat complacent to a 14- to 15- million bale cotton crop in the first half of the sixties. Suddenly, we were brought face to face with a series of crops in the 7 1/2-to 11-million-bale range which hurt all of us and was disastrous to some of our good friends. It is true, even if oversimplified, that the solution is to increase grower profits because he can and will produce cotton only if it is more profitable than other enterprises available to him.

Some excellent work is being done to recapture our lost fiber markets and I am

confident that we are going to see an upswing in demand. We all know there is a "magic" point in cotton price at which mills begin to use more synthetics at the expense of cotton. Therefore, as hopeful as we are for increased consumer demand, we have to work vigorously toward reduction of cotton production and handling costs. I am convinced the program which has now been placed in operation is the most comprehensive and visionary which has ever been undertaken. I believe the adversity of cotton production change, which has been so painful since 1966, has stimulated a complete revolution in production and handling practices. I am confident that this resolution is going to give cotton the most sound foundation it has ever enjoyed.

Thus, I think we are seeing change beget change, and I have the conviction that the ills of adversity many times can be the birth pains of new life if we have the vision and the courage to react constructively to adversity.

Just over the horizon there may be new oilseeds to be grown on our farms and processed in our mills. It is somewhat peculiar that U.S. production of sunflowers is almost insignificant while this oilseed ranks second only to soybeans and above peanuts and cottonseed in world production of oil. Considerable study, both public and private, indicates sunflower potential in Cotton States looks very promising.

F.R. Senti will be discussing with you the development of food grade proteins from oilseeds. Some of you are aware that our mill is installing a liquid cyclone plant to produce an edible protein from cottonseed. Our people recognized that the decision represented a considerable capital risk but felt we had no choice but to attempt this change from animal feed to human food. The concept has not been proved, but the potential is exciting. There is always the possibility that our management may someday have to tell our people their investment was a failure, but we believe this is going to prove to be the most dramatic change in cottonseed protein utilization since crushing first began. I want to pause here to express our appreciation of the outstanding research which the USDA Laboratory here in New Orleans has conducted on both the liquid cyclone process and the properties of cottonseed protein. Their achievements have made our venture possible.

I am anxious to hear with you during this conference three papers on cotton linters. I have often told our people that crushing mills have made less change in the lint room than in any other place and I was not necessarily being complimentary. Considering the high cost of delinting and the unfavorable outlook for linters, I am wondering if we have already procrastinated too long in seeking a change.

I want to recognize the importance of Stanley Campany's discussion of mill personnel without encroaching upon his subject. As we become more sophisticated in equipment and procedures we can no longer tolerate lack of efficiency in either supervision or workers. Changes must come about.

This conference will hear three important papers which have a definite relationship to Government control of processing procedures. We have experienced a somewhat gradual change toward more restrictive Government control over a long period of time. Quite suddenly, the whole problem has engulfed us to the extent that I suspect the operation of many mills might be stopped today with the very strictest enforcement of regulations. Fortunately, most regulatory officials are employing some degree of judgment for the benefit of those who consume and depend upon our products. However, these regulatory restrictions, many of which appear to be highly unrealistic and unnecessary, constitute problems with which we must deal and deal promptly. The very worst thing we can do is to adopt a "stick our head in the sand" attitude. We must bring about some changes.

No longer are we dealing with the somewhat bland problem of protein control in meal or insect fragments in oil. You name it, and we have Government control in operation or planned. There are comprehensive good manufacturing practices for sanitation, mold toxins, pesticide residues, air and water pollution, and employee health and safety standards, to name only a part of the list. Any one of these may cause a major problem.

Let us remember that in the larger sense we are dealing with more than regulatory officials, most of whom are attempting to perform their

duties fairly and realistically. We are dealing with antibusiness, antiestablishment, self-appointed spokesmen for consumers. The pressures they bring to bear upon agencies are almost intolerable. Who among us ever had the slightest impression that the Food and Drug Administration was oriented toward business? Yet, almost daily these ecology and health groups are attacking that agency and its officials with such an accusation.

We have always attempted to be good citizens who really care as much for our consumers and our neighbors as we do for ourselves. We need to re-examine our performance to determine that we are producing wholesome products and protecting an environment which is as important to us as it is to anyone else. We must be completely familiar with the requirements of regulations and know what must be done to be in compliance. We need to be alert to impending legislation and regulation promulgation and to make our input toward realistic, adequate control. We must move immediately toward remedying deficiencies which would keep us out of compliance. We shall need to employ research to develop facilities and procedures which are presently unavailable or excessively costly. Satisfactorily meeting these changes which have come upon us will frequently prove to be very difficult but I am confident that we are equal to the task.

I fear we have observed less emphasis upon the marketing of our products in many instances. For example, cattle feeding has provided the most dependable market for our meal and we have been rather passive in permitting urea and other nonprotein nitrogen to displace us. I hope we shall see a revival of salesmanship and less dependence upon simple order taking.

LONG-RANGE TRENDS IN OILSEED RESEARCH

by

F.R. Senti

Deputy Administrator

Marketing and Nutrition Research

Agricultural Research Service

U.S. Department of Agriculture

Washington, D.C.

It is particularly appropriate that my talk should follow the remarks by Roy Davis and the comments he has made on the changes that have occurred in the cottonseed industry. Of particular interest to us was the announcement he just made that the start of construction on the first commercial Liquid Cyclone Process plant in the United States is truly a milestone in the utilization of cottonseed, one of our three most important oilseed crops.

The title of my talk allows a great deal of

latitude. As a beginning I shall set some boundaries by saying that I plan to restrict my discussion to utilization research on oilseeds and shall talk principally about oilseed utilization research within the Department from 1940 to the present. I shall also make some comment on the trends we see for future research.

Utilization research on oilseeds, as well as other commodities, was not neglected in the earlier years, but during the approximately 80 years from 1862, which saw the beginning of

USDA, to 1938, when Congress established the four Regional Research Laboratories, the greatest emphasis was placed upon production research.

In 1933, science and technology had already assumed a new role with relation to industry and consumer goods, but the idea of new products through chemistry was still a new one to most consumers.

DuPont had just announced nylon, a product of the test tube, as the "miracle fiber" which would replace silk. The public in general, however, looked askance at most of the substitutes that were beginning to come from the laboratory in increasing numbers. Rayon was considered a cheap, shiny fabric which frequently failed to live up to the claims made for it. Margarine was a white, lardy-looking compound which came with a little envelope of yellow color. The housewife could blend this into the margarine to give it the color of butter, but most people who used margarine did so because they couldn't afford butter. Let us keep these facts in mind later on, when we consider some of the new products from oilseeds that were developed through research.

In a discussion of the changing trends in oilseed research, 1940 seems an appropriate starting point for more reasons than one. It is true that the research programs in USDA's Regional Research Laboratories began in that year, but this fact is overshadowed by the fact that 1940 marked a turning point in world history.

The Great Depression was ending as the eruption of World War II demanded the marshalling of all our resources to meet the new crisis. At the same time, the war set off sociological, economic, and technological revolutions which have affected the oilseed industry and oilseed research profoundly, just as they have affected every other phase of life.

Let us trace briefly the changes in research trends brought about by these and subsequent events.

When Congress authorized establishment of the Regional Laboratories in 1938, this country and its farmers were burdened with surpluses of every major crop, unmarketable through the usual channels.

The long-range objective in all our utilization research, on oilseed crops as well as other commodities, has been to make these products more profitable to the agricultural industry, through innovations in processing and product development. As a corollary, when we attain this objective, the consumer benefits most of all through availability of ample supplies of desirable products at reasonable prices.

Under conditions existing when the utilization research program was initiated in the

Regional Laboratories, the best route to this goal appeared to be the development of industrial uses for surpluses of farm products, supported by studies of chemical composition and analytical methodology. Some interesting products were developed from oilseeds, including synthetic rubbers from vegetable oils, and surfactants used in the making of GR-S rubber — products badly needed during the war years.

At one time, the coatings industry relied almost entirely upon linseed and soybean oils in the manufacture of paints and varnishes, but when this market was largely taken over by the petrochemicals it became necessary either to find new outlets for these oils, or to give them new properties, to enable the vegetable oils to meet their competition. ARS research in the regional laboratories has done both.

We have developed stable water emulsions of linseed oil so that linseed oil emulsion is now used in combination with synthetic polymers in many exterior latex paints because of the improved adhesion it imparts to the paint film. Linseed oil products are also being used as a coating for concrete streets and highways.

Soybean and cottonseed oils are both edible products, but both are also suitable for various industrial uses. Considerable research along these lines has been done at our Northern Regional Research Laboratory on soybean oil and large quantities are now being used commercially. Epoxidized soybean oil, produced by a reaction originally discovered at our Eastern Regional Research Laboratory in the course of research on animal fats, is widely used in the manufacture of polyvinyl chloride plastics. Other research findings have been commercialized through use of soybean oil in paints and varnishes, polyamide resins for coatings, dimer acids in alkyd resins, and in polyethers.

Research on the fatty acids of cottonseed oil, conducted at the Southern Regional Research Laboratory, also produced a number of compounds with excellent properties as plasticizers, some of which display superior properties under extremes of temperature. This latter property has aroused interest in some of these compounds for use in certain types of surgical equipment and also as a replacement for phthalate plasticizers in blood bags. You may have seen one of the many articles in the recent press which has expressed concern on migration of the plasticizer from the bag into blood. Although this is a limited use, it is quite interesting.

Development of extreme-pressure lubricants from cottonseed oil fatty acids continues with some promising results. Samples have recently been prepared for industrial evaluation.

Industrial products developed from the protein constituents in soybean, peanut, cottonseed, and other oilseed meals include such things

as plastics, adhesives, emulsifying agents, and textile fibers. What may develop into an extensive use for these materials is the exploratory work now underway on their use as foams for the protection of plants from cold, as carriers for insecticides, defoliants, and for other agricultural uses. This is a rapidly developing field and could furnish an outlet for vast quantities of material. Economics will, however, be a determining factor in the use of the vegetable proteins, as it is in so many instances.

The end of the war, in 1945, brought another shift in emphasis of research on oilseeds. Product development was expanded to afford greater emphasis on feed and food uses. The program was extended to include studies of processing methods, the effects of processing variables such as time and temperature upon yields and quality of the products, the effects of conditions of storage and handling of the raw materials upon the products. Special investigations were also undertaken, of gossypol in the case of cottonseed, and undesirable flavor constituents in the case of soybean oil.

The information thus accumulated has proved invaluable during the fifties and the sixties in expanding the utilization of both soybean and cottonseed products. Improvements in the quality of soybean oil have made it suitable to supply the increasing demand for cooking and salad oil, which has expanded phenomenally.

During this same period, the cottonseed meal industry saw opportunities for their product as a protein supplement to supply the poultry industry, particularly the broiler industry, which was booming in the South. Two principal factors inspired interest in the use of cottonseed meal in poultry feed — the desire for a more profitable outlet for the meal and the developing threat of ammonia and urea as a replacement in the traditional market, cattle feed.

Research conducted at the Southern Regional Research Laboratory, with the cooperation and support of the cotton and cottonseed organizations, was largely responsible for establishing guidelines for the proper processing to produce cottonseed meal suitable for feeding to poultry.

Technological advances in the food processing industry in the years of expansion following the war created an interest in new food products and new constituents to improve the vast number of prepared and convenience foods appearing on the market. Emulsifiers, binders, moisture-holding ingredients were being used in growing amounts.

All of these factors, together with an event which occurred in 1953, brought about another change in the direction of our research on oilseeds. The new factor which entered the

picture was completion of a report by a United Nations committee revealing an alarming shortage in world food supplies, particularly protein.

Specialists in the food field recommended plant materials as the most practical source of proteins to make up the deficit. The reason is obvious: Large quantities of edible oilseeds, such as peanuts and cottonseed were grown in the developing countries and crushed for oil, but their meals were used for fertilizer or were exported. Acting upon this recommendation, the Agency for International Development placed a number of short-term projects with the Regional Research Laboratories for the development from plant materials of new products suitable for human nutrition, and of course, processes for making these products. As a result, research on food products from plant materials such as soybeans, cottonseed, and peanuts was greatly expanded and accelerated.

Interest of food manufacturers in the United States in the use of oilseed proteins and other oilseed components in food had already been aroused because of their special properties and functionality and also because of price.

Adoption of cottonseed meal and protein products for food use has been handicapped by the presence of the gossypol pigments. ARS research has demonstrated that by careful processing this difficulty can be largely overcome. The Liquid Cyclone Process, however, must be regarded as a real breakthrough which, from all indications, will make possible the production of food-grade flour and protein concentrates and isolates from glanded cottonseed.

Some of these cottonseed products show special properties which should give them a distinct advantage in the food field. One of the major protein constituents has the property, unique among the vegetable protein products, of being soluble in mild acids, such as citric, making it suitable for enrichment of such things as soft drinks. With the current concern about inadequate diets among our teen-agers, because of their consumption of soft drinks and snacks, this might be an opportunity for manufacturers of some of these products. A good consumer test of such a drink was conducted at the Spring Fashion Buyers' Market in Dallas recently, when a citrus punch, enriched with cottonseed protein isolate, was served to some 4,000 people. Apparently it was well liked, as few glasses were left unemptied, even though champagne was being served also.

Glandless cottonseed would eliminate the problem of gossypol. The genetics of glandless seed have been thoroughly understood for a decade. As we look to the future we can recognize that development of meat analogs can present a dilemma for the oilseed industry. If oilseed protein products replace animal food

products, production of meat and dairy animals and poultry may be reduced with concurrent reduction in demand for protein supplements for feed. This is not a one-to-one replacement because animals and poultry are inefficient converters of feed protein to meat or milk protein, efficiency ranging from only 4.5 to 24 percent.

An alleviating factor will be the increased demand for animal products resulting from our growing population and rising income levels.

The impact on oilseeds will depend on which animal or poultry products are replaced in relation to the quantity of oilseed meal consumed in producing these animals.

For a particular oilseed, the situation also will depend on its suitability for conversion to a meat analog, or to serve as a food ingredient. In this respect, research will be needed to provide the necessary basis for development of each oilseed for this market.

Size of the food market for protein ingredients is indicated by a recent report in the Cereal Industry Newsletter (1(10): 1, Nov.-Dec. 1971), which stated that protein ingredients alone, derived from soybeans, milk and other natural sources used to fortify foods in 1971 amounted to \$450 million with \$680 million projected for 1975 and \$1.2 billion by 1980.

Certainly no market of this size can be ignored by the oilseed industry.

At the same time, we cannot neglect the opportunities and new requirements for oilseed meals in animal feed. Although it appears that our best prospects are in the development of supplements better suited to the feeding of the nonruminants, there may also be opportunities in ruminant feeds if the current emphasis on increased polyunsaturated fats in the diet continues. Animal fats and milk are low in polyunsaturated fats, but recent experiments have shown that the content of polyunsaturates can be increased by feeding vegetable oils which are high in polyunsaturates and which are protected from the action of the rumen micro-organism by proper chemical treatment.

Another development in the oilseeds industry has been the introduction of new oilseed crops. An active search is being carried on continually for new crops of all kinds, crops which will either furnish desirable new products, or meet specific needs. Out of hundreds of varieties and strains screened, only a few have value. One of our earliest introductions was the soybean, which has been notably successful.

Of more recent introductions, the sunflower and safflower are both grown on sufficient acreage to be considered commercial and a third, crambe, is in the process of introduction.

Strong impetus for introducing safflower and sunflower was the need for an additional

cash crop in regions to which the soybean is not adapted. Safflower is adapted to areas west of the 100th meridian. The oil is comparable to linseed oil as a paint ingredient and has the advantage that it is nonyellowing. As a food oil it is more flavor stable than soy.

Sunflower, although native to America, was developed as an oilseed by plant breeders in Russia. Sunflower oil fatty acid composition, when the plants are grown in northern latitudes, is comparable to corn oil. Both sunflower and safflower oil may have a marketing advantage because they are high in polyunsaturates.

The decline of cotton production in the South, and with it the production of cottonseed, has created a demand for an alternate crop, especially in areas where soybeans are not adapted. The National Cottonseed Products Association is interested in the possibilities of sunflower as a new crop for the South and is strongly supporting its introduction. ARS plant breeders have made considerable progress in developing high-yielding hybrid varieties. These successes, along with progress in improved cultural practices, are encouraging for its success in the South.

Sunflower must, of course, compete with soybeans in both the food oil and oilseed meal markets. In view of our production of a domestic surplus of vegetable oil, for large-scale production of sunflower our crop must be competitive in the world market.

Research on development of the sunflower has another value. Sunflower is a high oil, low protein crop as compared with soybean, which has low oil, high protein production per acre. If single cell protein production for feed uses becomes competitive with soybean meal in Europe and displaces soy meal from our foreign markets, meal prices might then drop and sunflower would become a more competitive crop.

The mycotoxins, and particularly aflatoxin, will be a subject for research for some time to come. It is likely this research will be expanded, because we are learning that this field is wider than we suspected. Not only is aflatoxin a problem in cottonseed and peanuts in some areas, but it has occurred in soybeans, corn, and tree nuts. Other mycotoxins have been found, also, in various products, and further exploration will be needed to discover the full extent of the problem.

Surveys of cotton fiber samples have indicated that boll rot caused by *Aspergillus flavus* is uncommon in most of the Cotton Belt but does occur repeatedly in the Imperial Valley of California and in the lower elevation areas of Arizona and Texas.

Efforts are underway in Arizona and California to reduce *A. flavus* boll rot, and in turn,

the contamination of cottonseed, through modification of cultural practices that include application of fungicidal and fungistatic compounds. Laboratory investigations on the factors affecting the infection process and the regulation of aflatoxin elaboration are being pursued.

The ammoniation procedure for treatment of aflatoxin-contaminated meals proved practical in commercial operations, and feeding tests of treated meals are now being conducted. Indications are that the treatment was effective.

Highly important from the standpoint of the oil mill operator is the millicolumn test for aflatoxin. This test, which can be done in 15 minutes by plant personnel without technical training, was used this year for screening incoming loads of cottonseed for aflatoxin contamination. By keeping out contaminated seed, the processors were able to produce meals with

aflatoxin below the FDA tolerance levels. These meals command a premium price.

From the foregoing, it must be obvious that the needs and the opportunities for research on oilseeds are even greater today than they were 30 years ago. Such research can be expected to cover industrial, feed, and food uses, with the only differences being toward greater emphasis on specialization to meet current and long-range requirements as these arise.

The accomplishments of ARS in oilseed research in the past have been aided greatly by the interest and cooperation of industry organizations and many firms and individuals. Without this assistance and support we could not have achieved nearly as much. We are sincerely appreciative of this attitude on the part of the oilseed industry and sincerely hope that it will be continued in the future.

UPDATING THE POSITION OF MILL MANAGEMENT PERSONNEL (SUMMARY)

by

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Coahoma National Bank
Jonestown Branch
Jonestown, Miss.

The title of this paper literally means bringing up to date the positions of the men responsible for the physical operation of your oil mill. The term "position" means the whole phase of their role in relationship to your mill.

The milling industry's concern over the inability to fill vacancies caused by retiring and deceased key personnel includes the following:

What does Management expect of key mill personnel?

What do the mill personnel expect in return?

What things are "bugging" existing mill personnel?

What factors are causing trainees to leave before their training is completed?

Why are there no applicants available for the many openings?

Today's youth is better educated, brought up in more affluent surroundings; therefore, he expects better conditions — more money, shorter hours, and greater benefits — than his father had.

Can today's mill offer the same money, hours, and chance for advancement that is offered a young man in the plumbing trade, or as an auto mechanic, an electrician's helper, or even a truck driver?

In general, today's mill is not in a position to offer competitive benefits because its method of operations is archaic — despite solvent extraction process and other developments.

Management must use disciplined procedures when dealing with shippers to his mill and with buyers to whom he ships his products. Haphazard receiving and shipping methods are costly in overtime, accidents, and break-downs.

What is needed to streamline a mill's operations? The following are suggested:

Start immediate plans for improving your present operating methods. Adopt a 6-month plan, a 1-year plan, and a 5-year plan.

Strive for flexibility in operations, whereby production can be increased — even to exceed your total cottonseed or soybean receipts.

See that management and superintendent work closely together for greater operating flexibility. An extra maintenance man could be hired to rebuild used machinery and to install emergency transmission and conveyor systems. Be able to increase daily capacity by 50 percent at will, without excessive labor costs and with small outlay for additional machinery needed.

Crash programs for improvement and repair are very costly to the mill and generally accomplished in such a short time that the end result is very shoddy workmanship. Such crash programs are generally caused by a wait-and-see attitude; that is, let's wait and see if we make any money this year.

Sometimes the best stimulus for running ahead is to have something to run from. Today's mill is running away from an obsolete state; or, at

least, it should be.

Being faced with higher operating costs every year should prompt every oil mill manager to seek ways of cutting costs. However, reduction in quantity or quality of mill management personnel is the worst possible way to cut costs.

The best possible way to cut labor and repair costs is to modernize, automate, and increase production.

A manager should have open communication with his key mill personnel, asking for their opinions and keeping an open mind for possible suggestions.

Mill operators should have at least a 30-day downtime repair season rather than run the mill from one season into another. Many improvements and repairs cannot be done properly without the mill being shut down.

Mill operators are too prone to use their status of agricultural industry as an excuse for not entering the general field of manufacturing and for employing the manufacturing method — as regards labor benefits, plant improvements, and so forth.

New government rulings on air and water pollution, noise abatement, health and accident regulations, and the Food and Drug Administration should serve as an inducement to improve and modernize every mill in this country.

After the initial shock of enforced modernization passes, mill managers will be proud of the plants they manage; and prouder yet of their ability to produce at voluntary accelerated rate rather than to plug along at peak load and be at the mercy of every buyer of his products.

SESSION I: George C. Perry, Mississippi Cottonseed Products Co., Jackson, Miss., Chairman

HOW TO CLEAN SECOND CUT LINTERS

by

Sidney Switzer

Plains Cooperative Oil Mill

Lubbock, Tex.

The first and most important step in making good second cut lint starts with how the seed is cleaned. I am sure everyone in this room will agree that this has to be the starting place. We all have seed cleaners, and if they are not in tiptop shape, they will not do much of a job in the lint room. One of the big problems in our cleaning room is that we all try to put too much tonnage over our cleaners. They are made to run a given number of tons and give us a good, clean seed to go to our lint room. When this tonnage is exceeded, problems are created down the line. I will not try to tell you how to dress and at what r.p.m. to run your cleaners because each mill has its own way with its own type of seed. I will tell you what we, at Plains Cooperative Oil Mill, Lubbock, are doing.

I can add one very important statement. No one in this room has any dirtier seed to start with than we have on the South Plains. These seed are, by far, the worst you will ever see.

We are running our Bauer 299 seed cleaners at 1,242 r.p.m. and shakers at 754 r.p.m. We have 5/8-inch punched, perforated metal on the top trays and 5/32 of an inch by 2 inches on the bottom two trays. With this dressing and r.p.m., we do a very good job of cleaning our seed. This is the first place to start to make good clean lint. From there we go to the first cut linters, then to the seconds and thirds. We then go to the lint beaters. We have Fort Worth B.C. beaters in the old mill, with B.C.'s in the new mill.

We have these dressed with 5/16-inch screen on the top pass, with 50 mesh on the pepper screens. We run our beaters at 980 r.p.m.

The two main points of keeping the beaters operating properly are (1) to see to it that the screens are always free from tears or holes, and (2) to make sure that the beaters are kept cleaned out. These are necessary steps because plugged beaters cannot clean the lint. This is the second most important thing in making clean second cut lint.

All of the reclaimed lint from the various points, shale section, salvage beater, and from the top of the salvage beater is returned to the second cut trunk line and recycled. Offhand, it might appear to be a bad practice to recycle all of the reclaimed lint, but it has been determined here at Plains Co-op Oil Mill that this procedure definitely improved the color of the lint, in spite of the increased load on the beater.

The operation of the second cut beater is relatively simple and, after proper adjustment, requires only normal maintenance and attention. The moting chambers or the various sections of the beater are essential features and, if properly adjusted, will remove considerable trash, hull particles, and seed that would otherwise go out with the finished lint. The moting chambers should be checked each day and adjusted, by means of the valve, to drop a maximum of trash. These adjustments are to be made by your linterman only.

The only possible optional arrangement on the second cut beater is to blend the lint from the upper portion of the shale section directly into the finished lint from the upper section going to the baling press.

The next step is the large 48-inch condenser. Although a lot of people will say this is not needed with our very dirty lint the condenser

screen helps clean some dirt out. Our condenser is dressed with 1/8-inch size screen and, with the volume of line we produce, we have to run this machine at 10 r.p.m. to take care of the capacity of this amount of lint. If we could run the machine slower, we could do a still better job of cleaning and obtain cleaner lint.

PROJECTION ON THE USE OF LINTERS IN THE BLEACHING INDUSTRY

by

Charles A. Montague, Jr.
The Buckeye Cellulose Corp.
Memphis, Tenn.

I have been asked to talk to you about the future of cotton linters in the bleaching industry. This is a timely subject because of recent changes in the supply and demand situation as it pertains to chemical linters.

While it is a timely subject, it is also a most difficult one because we are about to enter our last year of cotton production for which we have known legislation.

Since we cannot at this time confidently predict the future of either legislation or produc-

tion, I will not try to project the future in terms of tons and dollars. Rather, I would like to discuss some of the factors and trends that will influence the future and speculate as to the general direction in which these may take us.

As a point of departure, let's look briefly at the effect that cotton legislation has had on the production and supply of cotton in recent years (table 1). From this table you can see that there have been dramatic swings in the supply of cotton.

Table 1. Average of U.S. cotton production, yield, carry-over and off-take (000 omitted) crop years August 1 through July 31

Item	1961-62 through 1965-66 ¹	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1966-67 through 1971-72 ²
Cotton production in 500-lb. bales ³	14,952	9,575	7,458	10,948	10,009	10,184	10,548	9,787
Yield per harvested acre, pounds	492	480	447	516	434	437	442	460
Off-take — 500 lb. bales ³	13,116	14,154	13,200	10,808	10,778	11,500	11,100	11,923
Cotton carry-over end of crop year ⁴	12,285	12,270	6,448	6,521	5,760	4,500	3,300	6,467

¹Five-year average.

²Estimated 6-year average.

³Reported figures in millions of 500-lb. bales — do not necessarily add.

⁴Carry-over — The carry-over of U.S. cotton July 31 each year is the sum total of all bales of U.S. inventory of unopened cotton, regardless of location. This includes stocks of consumers, stocks in warehouses and compresses, Cotton Commodity Credit inventory, stored on farms, stored at gins, in transit, and on ships in ports awaiting clearance for export.

Now, let us relate these dramatic changes to linters. Let's begin by looking again at cotton production for the period 1963-64 through 1971-72 (estimate) expressed graphically (fig. 1). Let's superimpose upon that, linter pulp and wood pulp prices (fig. 2). The wood pulp price shown is high tenacity, viscose dissolving grade. As such, it is priced between premium ether and acetate dissolving grades with which linters also compete.

From these combined charts, we can see that during the 5 years ending in 1965-66, cotton production averaged almost 15 million bales per

year. Linter pulp volume swelled during this period of stable and relatively low price. Due to their great purity and high viscosity, linters pulps, under these stable market conditions, were preferred to wood pulps for most applications.

When cotton production and linter supply shrunk under the Food and Agriculture Act of 1965, nobody wanted to give up the cotton pulps about which their manufacturing processes were optimized. None considered himself to be a marginal user. It is not surprising then, with first a 33 percent reduction and then a 50 percent

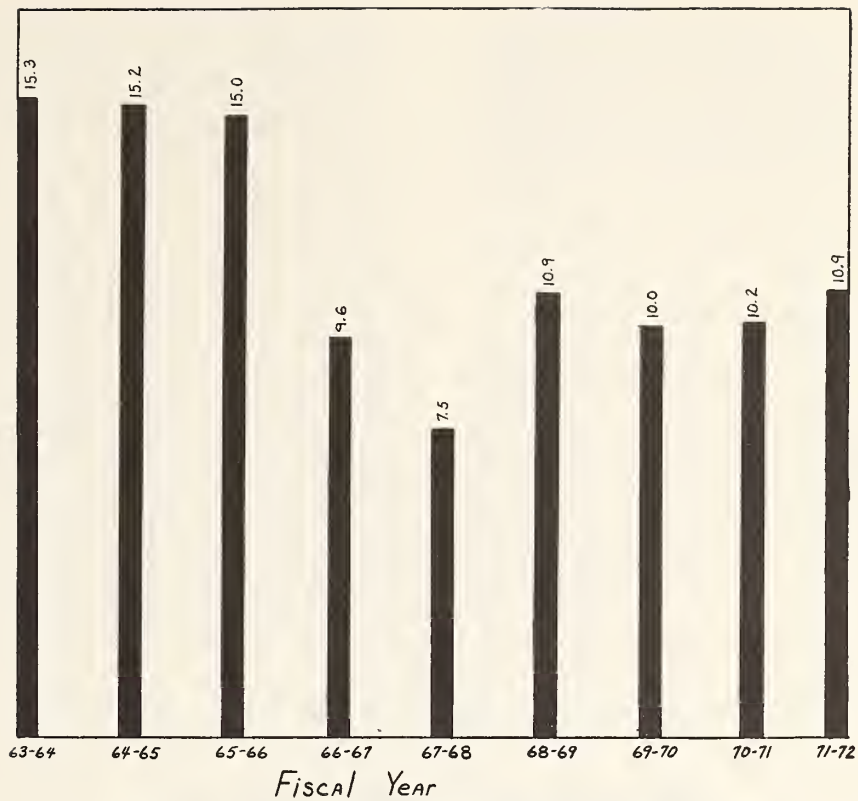


Figure 1. Cotton production — millions of 500 lb. bales

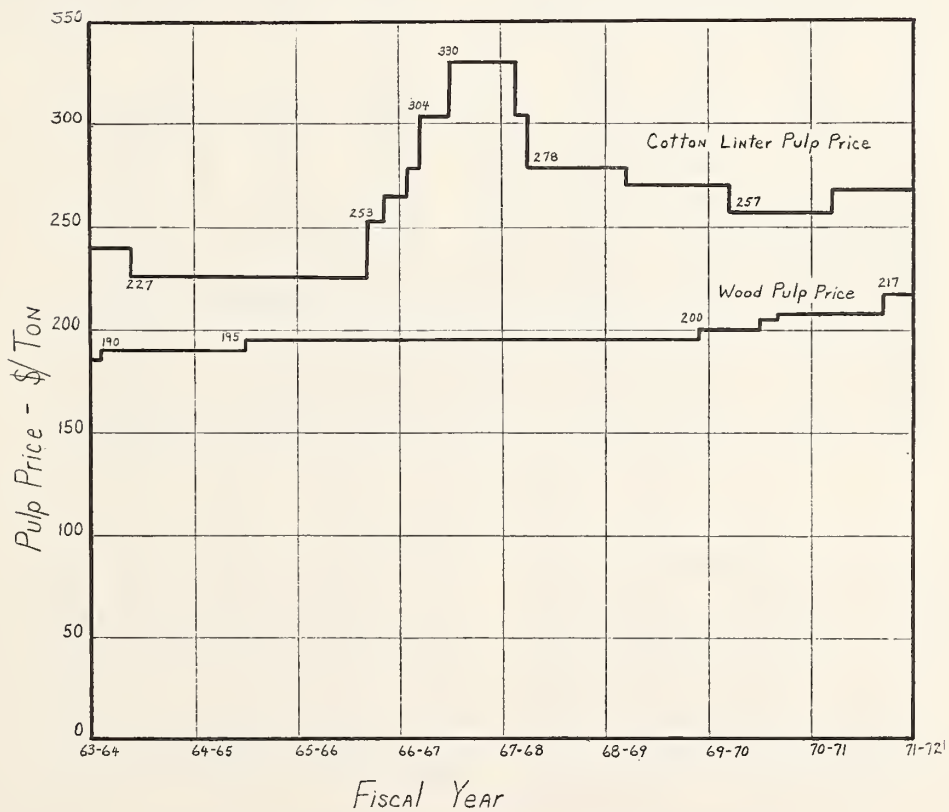


Figure 2. Cotton linter pulp and wood pulp price history

reduction in cotton production, that linters and linters pulp prices escalated sharply in 1966-67.

To make matters worse, an old and almost forgotten user reappeared — a user who would not be denied. He entered the market armed with adequate funds and a DX priority. He

demanded substantial volume “off the top” and sparked the fires of speculation and hoarding in linter and linter pulp markets. I refer to revived U.S. Ordnance demand arising out of the war in Vietnam. Our next chart shows this demand (fig. 3).

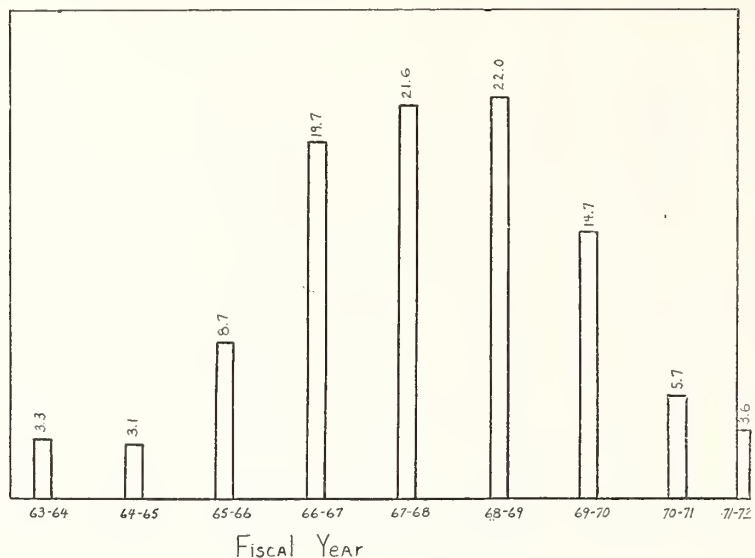


Figure 3. Ordnance pulp demand — tons x 1,000

Our next chart (fig. 4) shows total bleacher consumption during the period. This serves as a measure of just how well bleachers maintained their pulp volume in spite of the reduced cotton

production, short linter supply and high pulp prices. Bleachers were able to maintain volume only by buying a larger share of the smaller total linter production — and at higher prices.

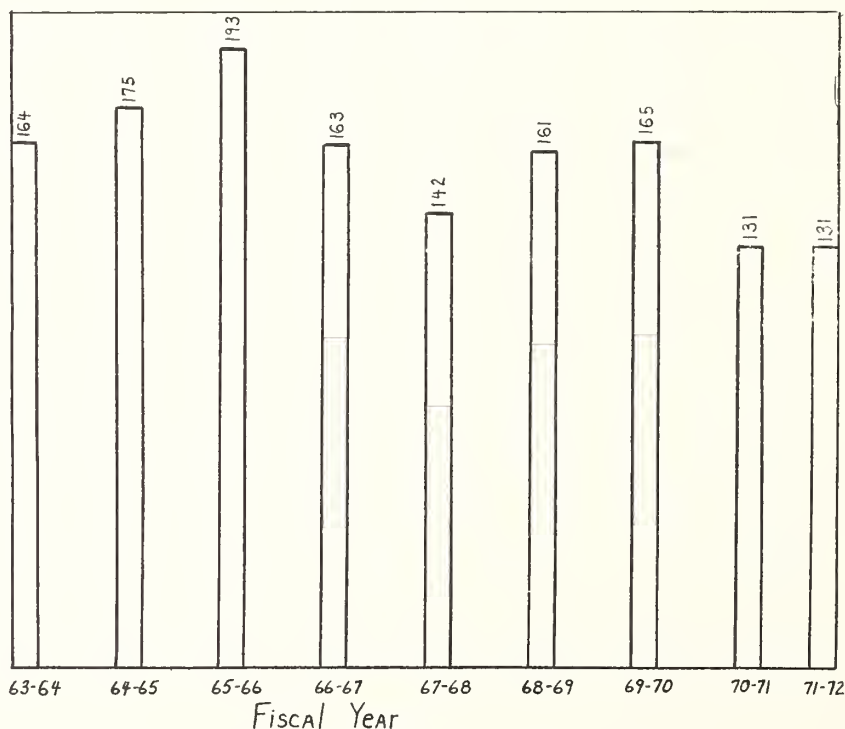


Figure 4. Estimated bleacher consumption — tons x 1,000

Even though bleachers were able to maintain their volume, this period wrought important changes in the cotton linter pulp business. Our major cotton linter pulp customers initiated crash programs toward the use of wood pulp. Sophisticated and specialized wood pulps poured from the labs, and they still do. Despite a prompt return to adequate supplies of cotton linter pulp (although at premium prices) many of our former hard-core users have, in the period between 1966 and the present, found it possible to turn largely to wood pulp. Many ether, acetate, viscose, and paper customers now use wood in former linters-only applications. Even the fellow with the DX priority now minimizes linter pulp usage and substitutes wood pulps in items made, until recently, only from 100 percent linters. His demand for cotton linter pulp is down to some 10 percent of the 1966 level. It is unlikely that these converted uses will ever return to linters at any premium in price.

Probably the most important long-range result of this crucial period was the forced realization by customers that wood pulps could be successfully used in former linters-only applications. Many such resulting losses of linter markets will never be won back to linters since specialized wood products are completely satisfactory — and in some instances superior. In some specialty applications still further losses are anticipated.

This is not surprising if we look at our next chart (fig. 5) which shows the relative prices of linter and wood pulps. You will see that the volume of linter pulp has been essentially maintained in spite of really substantial premiums. This speaks to the superiority or desirability of linter pulps in selected applications. It does not, however, suggest that linters can command these kind of premiums in substantially greater volume.

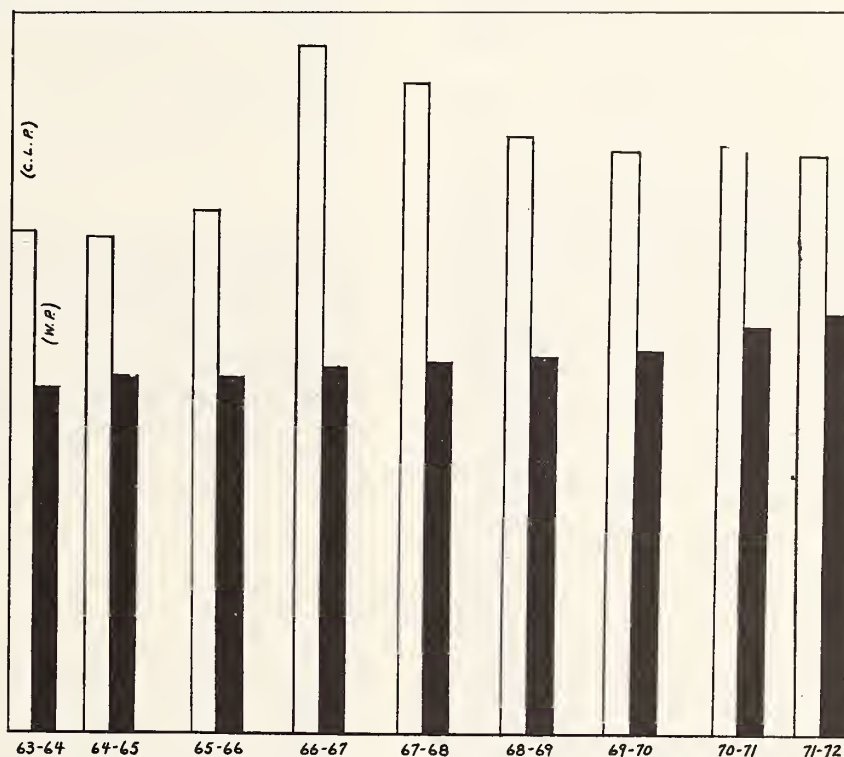


Figure 5. Wood pulp versus cotton linter pulp prices

Some 2 million tons of combined dissolving wood pulp and premium paper pulp are made in North America. These are the pulps with which cotton linter pulps compete. Contrasting this, only some 150,000 tons of linter pulp are manufactured. Obviously, then, linters pulps supply substantially less than 10 percent of the total demand. It is, of course, supplying the most critical qualities. However, to try to sell linters pulps at today's prices into markets which do not need or cannot capitalize on their

superior properties would be like trying to sell cottonseed oil or meal at prices some 30 to 50 percent above equivalent soybean products. At one time it may have been possible, but developments in the manufacture and use of the alternate products now make it impossible.

To save time, let me now draw conclusions from developments that occurred during this turbulent period of high prices and short supply.

1. Linter pulp prices for 1966-67 certainly should represent the extreme of high prices. The

coincident effects of war, crop failure, and dramatically bullish legislation surely will not recur simultaneously.

2. The development, availability, and economy of new and sophisticated wood pulps act importantly to lower the premium at which cotton linter pulp will, under most any circumstances, command.

3. However, due to the many desirable properties of cotton linter pulp (both practical and aesthetic) linter pulps have never in recent history sold at prices below the best dissolving wood pulps. Generally speaking, they probably should not be expected to do so in the future — certainly not significantly below.

4. The difference between cotton linter pulp and wood pulp prices is likely to narrow in the near future because of spiraling increases in wood pulp costs and increasing interchangeability between wood and linter pulps.

5. Based on the above, we expect linter pulp demand to stabilize and perhaps begin to grow, as compared to 1970-71 consumption, at about present pulp price levels.

Over the past year or so, wood pulp production costs have gone up substantially with labor, pollution control, and raw material costs. Slow demand has made it impractical to pass these costs along. As the level of business activity increases, we expect that wood pulp prices will rise faster than linter pulp prices. This should increase the attractiveness of linters pulp.

Only in the event of a substantial increase in cotton production would we expect linter pulp prices to decline, or need to decline, significant-

ly, in order to place the available volume. One exception to this might occur if slow demand or surplus supply of wood pulp prevented needed increases in wood pulp prices.

However, under any market conditions, linters pulp must demand a premium price to justify the cost of low-volume, specialty manufacturing. So long as it must, quality superiority will be needed if volume is to be maintained. So long as that is the case, clean raw lint will be needed and it will demand a premium price. It is becoming harder and harder to find “forgiving” markets that can capitalize on linters quality if the linters quality is not topnotch.

It will take the best efforts of all of us to assure good markets for chemical linters in the future. The sale of a premium priced industrial product is never automatic. The quality must be there if the price is to stand! The best assurance of a sound future for chemical linters is the building of a dependable supply of clean linters. This includes encouraging the control and eradication of the cocklebur, proper ginning and seed handling practices, and, of course, proper oil mill operation.

The absolute necessity of these things will depend upon just how much linters and linter pulp we need to sell. Right now, when we are trying to expand sales by pushing wood pulps out, every ounce of quality is important. For all of us, I hope that cotton production in the future is such that we will need to sell a lot of linter pulp! Both the oil mill and bleaching industries have suffered enough from the high costs of running plants at partial capacity.

THE OUTLOOK FOR THE USE OF LINTERS IN COTTON BATTING

by

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The major markets for first-cut linters have traditionally been in cotton batting for mattresses, automobile seating, and furniture.

For the period 1962 through 1969, the last year for which complete statistical data is available, the average annual usage of cotton batting amounted to about 1 million bales of fibers. Of this, total linters accounted for about 553,000 bales, or just at 57 percent of the total fiber usage as is shown in figure 1.

During the period 1962 to 1969, the average yearly consumption of cotton batting in mattresses amounted to 641,000 bales of fibers of which 350,000 were linters. During this same period the annual consumption of cotton batting in automotive end uses averaged 271,000 bales of fibers of which 148,000 were linters. In

the same period, furniture end use of cotton batting averaged 93,000 bales of fibers, of which 55,000 bales were linters.

Considering that there were several short crop years in the 1962 to 1969 period, the utilization of cotton batting in cushioning markets has declined consistently, with only a minor increase in 1965 to 1966, as shown in figure 2. The largest loss in markets has been in automotive seat cushions, and the trend in this market during 1970 and 1971 seems to be an accentuated decline. Some of this decrease can be attributed to the decision of General Motors Corp. to gradually eliminate cotton padding in their vehicles.

Figure 3 graphically illustrates the usage of cotton batting cushioning and padding markets

FIBERS IN COTTON BATTING

AVERAGE ANNUAL USAGE 1962-1969
(THOUSANDS OF 600 LB. BALES)

	LINTERS	+	TEXTILE WASTES	=	COTTON BATTING
BEDDING	350		291		641
AUTOMOTIVE	148		123		271
FURNITURE	55		38		93
TOTAL	553		452		1005

Figure 1. Fibers in cotton batting. Average annual usage 1962-1969 [thousands of 600 lb. bales].

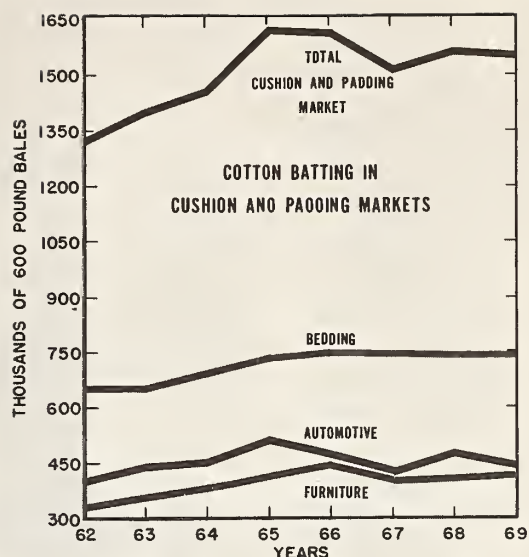


Figure 3. Cotton batting in cushion and padding markets.

COTTON'S SHARE OF CUSHION AND PADDING MARKETS

1962 - 1969

%

	1962	1963	1964	1965	1966	1967	1968	1969
BEDDING	88.6	88.2	85.9	85.5	86.2	85.4	86.2	85.8
AUTOMOTIVE	66.8	61.5	60.5	62.5	62.5	62.4	61.3	61.1
FURNITURE	29.2	28.2	27.0	25.2	23.8	22.2	21.8	22.2
TOTAL	68.3	66.4	64.0	63.4	63.3	63.1	63.0	62.7

Figure 2. Cotton's share of cushion and padding markets 1962-1969 (percent).

for the 1962 to 1969 period. In bedding and furniture, the market has remained essentially static since 1966, while in automotive seating cotton has been losing ground since 1965, with a minor increase being shown in 1968.

When the above data are plotted to show the utilization of linters as a component of cotton batting, the decrease in consumption is more apparent (fig. 4). As late as 1965, about 415,000

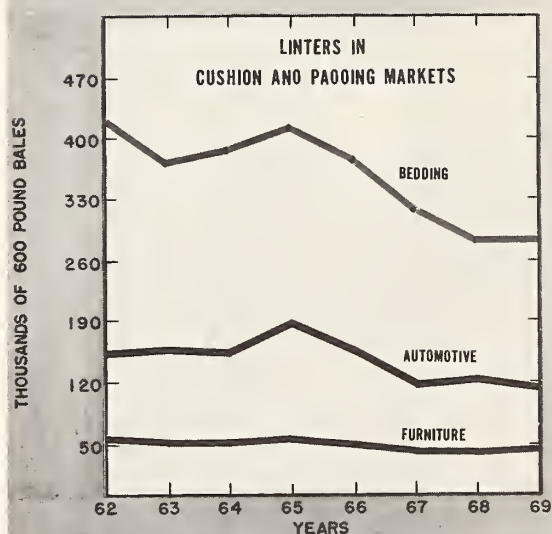


Figure 4. Linters in cushion and padding markets.

bales of linters went into bedding, about 190,000 bales into automotive, and 55,000 into furniture. By 1969, the use of linters in cotton batting had shrunk to 280,000 bales in bedding, 120,000 in automotive and 50,000 in furniture.

What now seems of great importance in the future of markets for cotton batting and ultimately linters is the recent interest of the Congress in "Consumer Safety."

On September 9, 1966, the Congress enacted Public Law 89-563 which requires that materials being used in automobile interior trim be made flame retardant. On December 14, 1967, the Congress enacted Public Law 90-189 consisting of amendments of the Flammable Fabrics Act of 1953. This law expanded the coverage of the Flammable Textiles Act to include mattresses, upholstered furniture, and other household articles. Both laws were acted upon during 1971 by the Governmental Agency responsible for the implementation of the particular law. On January 8, 1971, the Department of Transportation published in the Federal Register, Motor Vehicle Safety Standard 302 covering the Flammability of Interior Materials used in Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Busses. The standard selected is a horizontal burning rate test. The test method involves the testing of a sample of each component of the automobile seat, and the testing of the built-up composite seat. Samples for the test (4 by 14 inches with a maximum thickness of 1/2 inch) are placed between U-shaped frames in a special chamber. The flame is applied by a vertically oriented bunsen burner to the sample at the open end of the U-shaped frame. Flame time is 15 seconds. The frames are marked at 1 1/2 and 11 1/2 inches. Burning time is measured once the flame of the ignited material reaches the 1 1/2 in. mark. Maximum permissible burning rate is 4 inches per minute. The effective date for materials to meet the standard is September 1, 1972.

On September 9, 1971, the Secretary of Commerce published in the Federal Register a Proposed Flammability Standard for Mattresses. The proposed test involves placing three cigarettes at various positions on the bare mattress, and three cigarettes between two sheets on a mattress. If the charred area extends more than 1 inch in any direction from the cigarette, the mattress is considered to have failed the test. Comments on the proposed standard were received by the Department of Commerce up to October 9, 1971, and a final standard is now in the process of being prepared. The final version of the standard will take effect one year after it is formally published in the Federal Register. The enactment of the flammability standards for materials used in the interior of automobiles may have a salutary affect upon the consumption of cotton linters.

Since the standards for flammability established by the Department of Transportation (DOT) for automobiles and by the Department of Commerce for mattresses are so different, each of the markets for cotton batting, and ultimately for linters, will be discussed individually. It should be noted that the Department of Commerce will be responsible for flamma-

bility standards for upholstered furniture; however, no action to initiate such standards has been undertaken up to this time.

Flame retardance treatments for both Cotton Flote and for conventional cotton batting have been developed at this laboratory. These treatments appear to be economically feasible, with flame retardance being imparted to Cotton Flote for about 1.5 cents per pound of product, and to conventional cotton batting for about 3.25 cents per pound of product. In contrast it has been estimated that polyurethane foam, the major competitive material, will cost 10 to 15 cents per pound more if it is made flame retardant.

For both Cotton Flote and conventional cotton batting, the chemical systems found to impart adequate flame retardance are of the semidurable class. "Semidurable" in this context simply means that the flame retardant can be removed by multiple launderings. It does not mean that the flame retardant is not permanent for the life of the product. The urea phosphates, the borated amido polyphosphates, phosphorylated derivatives of dicyandiamide, and several others have been found to be effective. Add-on levels of 3 to 8 percent by weight of the cotton in the Cotton Flote product are needed, while for conventional cotton batting add-on levels of 8 to 12 percent are needed. The products containing these flame retardants easily pass a vertical flame test, and have burning rates of less than 1 inch per minute by the Department of Transportation Standard 302, when tested as an individual component. It is of interest that a synergistic effect attributable to the close proximity of dissimilar materials occurs when such products are tested as a built-up composite.

Note from figure 5 that the treated batting (second sample from the left) had a zero burn rate by the DOT Standard 302 when tested individually, and that the upholstery fabric (center sample) burned its entire length at a rate of about 3.5 inches per minute. When these two materials are combined for testing (first sample on left) the burning did not propagate the length of the sample but was considerably greater than for the treated batting. The second sample from the right shows the performance of untreated cotton batting. The sample burned its entire length. Burn rate was about 3 inches per minute. When this untreated batting was combined with the upholstery fabric (center sample) which had also burned its entire length, the composite (far right sample) self-extinguished in a shorter burn length than did the treated material.

Generally, it can be predicted that any cotton batting product that will pass the vertical flame test will easily pass the horizontal test of the Department of Transportation.

The cigarette test of the Department of

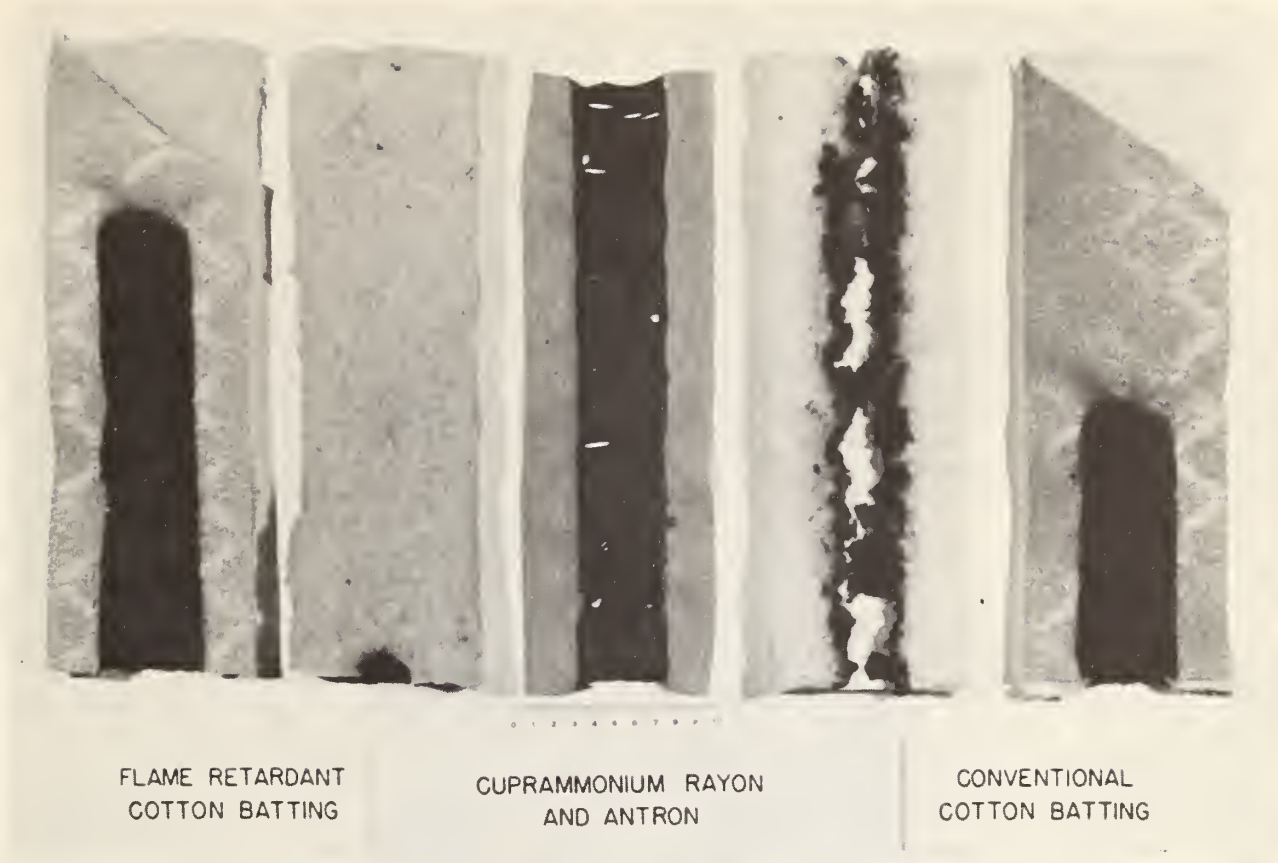


Figure 5. Composite and component response to horizontal flame test

Commerce is another matter. The average burning temperature of a cigarette of the type or brand suggested by the Department of Commerce for use in their standard for mattresses is about 1,000° F. This temperature is considerably below that of the bunsen burner flame (about 1,600° F.) used in the vertical and horizontal flame tests. It could easily be concluded that any product that would pass the vertical flame test would readily pass the cigarette test. This would, of course, be fallacious. The exposure time in the vertical test is 12 seconds, and in the horizontal test 15 seconds. In the cigarette test the exposure time is about 20 minutes. As a consequence, the sample being tested by the cigarette is subjected to 8 to 10 times the thermal energy that accompanies the vertical or horizontal flame test.

Cotton batting is a good insulator. It absorbs heat, but does not convect, conduct, or radiate heat. As a consequence, even flame retardant treated cotton batting can be ignited by a cigarette when it is fabricated into a mattress. Once the batting is brought to a state of smoldering combustion, the heat of oxidation is retained and the reaction becomes self-sustaining. Such slow smoldering combustion can take place in atmospheres containing as little as 1 percent oxygen.

An analysis of the problems associated with the ignition of mattresses by cigarettes indicates that classical flame retardance theory cannot be employed. In classical flame retardance, effective chemical systems direct the course of pyrolysis to yield increased amounts of solid byproducts and reduced amounts of gaseous byproducts to minimize flaming combustion. In contrast, smoldering combustion, as it occurs in a mattress that has been ignited by a cigarette, involves a direct oxidation from the solid state. As a consequence, the employment of the classical flame retardants would generate more fuel for the smoldering combustion.

Figure 6 shows typical performance of a mattress constructed of conventional untreated cotton batting along with untreated ticking. In an interlaboratory series of tests aimed at evaluating the reproducibility of the proposed Department of Commerce standard ignitions were obtained in 98 percent of the cases where the burning cigarette was placed in the valley of the rolled edge. Similar ignition was obtained when the cigarette was placed on the stitching of the quilting as shown in figure 7.

Sample mattresses made with treated ticking, treated batting, and combinations thereof, also failed the cigarette test.

An analysis of the research data for develop-



Figure 6. Typical performance of untreated cotton batting mattress when evaluated by the cigarette test



Figure 7. Typical ignition by cigarettes on quilting and tape edges

ing cotton batting products that, when used in mattresses, could pass the cigarette test indicated that the problem of heat transfer was more important than chemical interference with the course of pyrolysis. Dispersion of the heat from the cigarette so that the underlying batting does not reach a temperature which could initiate smoldering proved promising. A number of samples of ticking were backcoated with thermoplastic latices to which sufficient aluminum pigment had been added to yield a product that contained between 1.25-and 1.50-percent aluminum by weight of the cotton ticking. When these products were used on sample mattresses, ignition by cigarette was inhibited. Other techniques that seem promising include placing several strands of fine wire in the rolled or tape edge; the use of tapes containing metallic yarns; the use of intumescent materials instead of aluminum pigment in the backcoating; and the use of alumina trihydrate instead of aluminum powder in the backcoating.

What is the outlook for the use of linters in cotton batting?

At the present time it appears that flame retardant cotton batting products that will pass the Department of Transportation Standard for automobile interior trim are feasible, at a cost that the industry can bear. In fact, the cost of flame retardance appears to favor cotton over polyurethane foam. A bale of flame retardant treated cotton batting rawstock made up to 60-percent first cut linters by weight and 40-percent textile waste fibers by weight has been garnetted and fabricated into automobile seat cushions by Burton Dixie Corp. These seat cushions are currently being evaluated by Ford Motor Company in 15 vehicles on their test track. We have been asked to treat several more bales of fibers so that 72 additional cars can be equipped with the flame retardant cotton batting. Unfortunately we do not have the equipment or the personnel to undertake this job. We have been working closely with Lummus Industries, Inc., of Columbus, Ga. This company has taken our research findings, and with some modifications of their own, are building a prototype plant for impregnating cotton batting

rawstock with flame retardants. This prototype plant will be capable of treating the fibers at the rate of 4,000 to 6,000 pounds per hour. The equipment to do the job has been estimated to cost between 40 and 50 thousand dollars. If the equipment is written off over 5 years this will amount to \$0.0008 per pound of product. A demonstration run in this plant is scheduled for February 16, 1972.

With regard to mattresses, our findings indicate that it is possible to construct cotton mattresses that resist ignition by cigarettes. The most promising approaches involve heat dissipation so that the critical temperature for the ignition of the batting is not reached. Backcoating of the ticking with latices and suitable heat sink materials appears to be the least costly approach.

It should be emphasized that even though our research data to date indicate that heat transfer rather than chemical alteration of the course of combustion seems to be the most promising approach to passing the Department of Commerce standard for mattresses, this should not be interpreted as meaning that flame retardant treatments for the batting are unnecessary. We are convinced that the cigarette test is the first generation standard and that open flame test will be required within the next few years.

Undoubtedly standards for upholstered furniture will be issued by the Department of Commerce in the foreseeable future. What these might be is difficult to predict.

In summary then, the markets for linters in cotton batting for automotive end uses do not appear promising, even though cotton batting products that meet the Department of Transportation standard are available. In mattresses, the markets for linters can be expected to remain stable, at least for the balance of 1972. It is hoped that the answers we seek for the development of mattress constructions to pass the Department of Commerce standard will maintain these markets in the future. We feel rather confident that cotton batting products acceptable for use in mattresses will pass any standard that is ultimately set for upholstered furniture.

THE ECONOMICS OF GROWING COTTON VS. EXISTING ALTERNATIVE CROPS

by

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Today's farmer regards himself as a businessman with a primary concern to provide a livelihood for himself and his family. Perhaps for this reason, most economic research is conducted with the assumption that maximizing profits is his ultimate goal. However, there may be several factors or conditions which prevent the farmer from attaining maximum profits. These include institutional restraints — lack of money credit (high interest rates); personal restraints — desire for leisure, desire to increase farm size, desire for farm survival; resource restraints — lack of land, lack of available labor, and so forth. More often than not, different farm operators face different sets of limitations. Thus, each producer places his own peculiar stamp on a production decision.

Historically, acreage for most crops has been controlled by allotment restrictions; further, the crop had to be planted to receive price support payments. The Agricultural Act of 1970 has introduced a new dimension to the evaluation of profitability among competing crops. The returns from many crops are enhanced by farm program payments. Under the new program, the acreages are not restricted and, with the exception of cotton, payment is not conditional upon planting the crop. Thus, in theory, the farmer can receive the government payment and still plant his entire farm to the most profitable crop.

Present legislation provides that a farmer must plant at least 90 percent of his cotton allotment to receive the full price support payment for his farm. He is free to plant additional acreage but will receive no additional support payments. In 1971, the first year under the new program, the total acreage of cotton planted in the United States was slightly more than the total U.S. allotment. It is likely that much of this overplant can be attributed to a desire to protect the total farm production to avoid the risk of a lower average payment yield.

If this is true, it would appear most farmers decided that other crops were more profitable than cotton without support payments.

The purpose of this paper is to present an analysis of the competitive position of cotton, based on the profitability cotton holds in relation to other crops. The distinctions are based on average costs, prices, and yields. An individual producer's position may differ substantially from the average situation given in the analysis.

In making a farm management decision to produce cotton, a farmer usually determines two things. First, can he make a profit growing cotton? Second, can he make more money growing cotton than some other crop? For the past several years, the U.S. Department of Agriculture (USDA) has developed extensive data on the cost of producing upland cotton ^{1, 2, 3, 4}. These data can give us a good picture of the expected profit from producing cotton. Unfortunately, there is not a readily available source of such extensive information on the cost of producing other crops. However, there are several sources of input-output budgets for various crops which can be used to compare with cotton.

Is Cotton Profitable? The cotton cost survey report for 1969 indicates the average direct cost per pound of lint in the U.S. was 25.0 cents and the average total cost was 32.0 cents (table 1). Total cost includes a charge for land and general farm overhead expense. Thus, the average cost of producing cotton was greater than the market price received but smaller than the combined market and support price which averaged 36.0 cents per pound for the year.

The 1969 costs were higher than those reported for 1965 or 1966. In 1965, total costs were 27.3 cents and direct costs were 20.9 cents. In 1966, the corresponding costs were 26.6 and 20.6 cents, respectively. However, in 1969, the

¹ Starbird, I. R., and Hines, F. Costs of Producing Upland Cotton in the United States, 1964. Agr. Econ. Report No. 99, Econ. Res. Serv., USDA. September 1966.

² Starbird, I. R., and French, B. L. 1965 Supplement to Cost of Producing Upland Cotton in the United States, 1964. September 1967.

³ Starbird, I. R., and French, B. L. 1966 Supplement of Cost of Producing Upland Cotton in the United States, 1964. September 1969.

⁴ Starbird, I. R., and French, B. L. Cost of Producing Upland Cotton in the United States, 1969. A preliminary report, Econ. Res. Serv., USDA. October 1971.

Table 1. Upland cotton: average yield, average production costs, and receipts per pound of lint, 20 regions, 1969, with U.S. comparisons for 1966 and 1965

Region	Per acre har- vested	Direct costs per pound ¹	Total cost per pound ¹	Receipts per pound ²
	Pounds	Cents	Cents	Cents
SE-1: Southern Piedmont	421	30.4	37.6	37.4
SE-2: Eastern Coastal Plains	442	36.7	43.1	39.5
SE-3: Southern Coastal Plains	393	40.4	46.5	40.2
SE-4: Limestone Valley — Sand Mountain	457	24.5	31.6	35.9
SE-5: Clay Hills	495	25.8	32.7	36.7
SE-6: Black Belt	437	29.6	35.7	36.6
SE-7: Brown Loam	519	23.4	29.8	34.7
SC-1: Mississippi Delta	559	22.4	28.7	35.0
SC-2: Northeast Arkansas	496	23.4	28.7	32.6
SC-3: Black Prairie	176	30.1	39.0	41.7
SC-4: Coastal Prairie	294	25.3	33.1	36.5
SC-5: Lower Rio Grande Valley	512	24.9	31.7	33.7
SC-6: Rolling Plains	284	19.2	26.3	34.5
SC-7: High Plains	339	24.4	31.7	35.7
W-1: San Joaquin Valley	818	25.0	33.1	38.7
W-2: Southern California and Southwest Arizona	1,110	26.6	32.7	34.0
W-3: Central Arizona	955	29.5	36.1	34.5
W-4: High Southern Desert	843	27.4	34.0	35.0
W-5: Upper Rio Grande-Pecos Valleys	603	27.0	36.3	38.1
W-6: Trans Pecos	642	37.3	46.3	43.5
United States: 1969	455	25.0	32.0	36.0
1966	518	20.6	26.6	30.5
1965	576	20.9	27.3	28.4

¹ Value of seed subtracted from total costs of producing lint and associated seed, divided by yield plus an allowance for the weight of the bagging and ties.

² Market price plus price support payment.

Source: See footnote 4, p. 20 (pp. 7-8).

average combined price received was also higher than the 28.4 cents and 30.5 cents received in 1965 and 1966, respectively. Much of the increase in average cost per pound of lint for 1969 can be explained by the decline in average yield to 455 pounds in 1969 from 518 pounds in 1966 and 576 pounds in 1965.

There are producing areas within the United States where the cost of production is much lower than the U.S. average. A comparison of the cost and the receipts per pound for the areas in 1969 are also shown in table 1. The lowest cost area in 1969 was the Rolling Plains of Texas and Oklahoma at 26.3 cents, with the Delta and Northeast Arkansas second at 28.7 cents per pound of lint. The highest cost area was the Southern Coastal Plains of Georgia and Alabama at 46.5 cents per pound. The low cost areas have varied from year to year in the survey. For the three year period 1964 to 1966, the Texas Coastal Prairie had the lowest average direct cost

per pound of 17.4 cents, with the Black Prairie, Delta, Southern California, Rolling Plains, and High Plains having an average direct cost of less than 20 cents.⁵ The Delta had the lowest average total cost of 24.1 cents per pound of lint for the 3-year period.

Within a given region or area, the per acre cost of producing cotton does not vary greatly. In general, most farmers within the area use the same general cultural practices. Granted, some farmers do have some innovative practices and economics of scale but the general cost per acre is relatively stable from farm to farm. Thus, the real factor which affects the cost per pound of lint on a given farm is apparently the yield per acre. These differences in per acre yield are responsible for a wide distribution of cost per pound of lint within the area. A distribution of production by cost per pound of lint for the Delta and Northeast Arkansas in 1969 are shown in table 2. Of all cotton produced in the Delta,

⁵ See footnote 3, p. 20 (p. 12, table 2).

Table 2. Cumulative percentage of upland cotton produced below specified cost levels, Mississippi River Delta and Northeast Arkansas, United States, 1969

Cost per pound of lint	Mississippi River Delta			Northeast Arkansas		
	Direct costs only ¹	Direct and overhead costs ²	Direct, overhead, and land costs ³	Direct costs only ¹	Direct and overhead costs ²	Direct, overhead, and land costs ³
	Percent	Percent	Percent	Percent	Percent	Percent
Less than 15 cents	18.9	8.7	4.1	11.7	5.3	0.0
Less than 18 cents	37.4	28.6	5.4	28.6	18.3	1.8
Less than 21 cents	55.3	39.6	22.8	44.2	37.3	11.6
Less than 24 cents	66.3	57.8	38.5	67.0	51.6	27.8
Less than 27 cents	77.3	68.6	51.1	80.7	70.8	42.7
Less than 30 cents	87.7	79.7	63.2	87.6	82.3	64.6
Less than 33 cents	93.7	88.7	76.2	93.9	39.4	79.6
Less than 36 cents	95.0	92.6	84.4	96.1	92.8	86.8
Less than 39 cents	96.2	94.5	91.2	97.6	95.2	92.4
All levels of cost	100.0	100.0	100.0	100.0	100.0	100.0

¹ Includes the cost of labor, power and equipment, all materials (seed, fertilizer, herbicides, insecticides, defoliants, and other chemicals), ginning, custom services, irrigation, and interest on operating capital.

² Includes direct costs plus the annual costs of overhead items of real estate and social security taxes, insurance expenses, administrative costs, and maintenance of drainage ditches, fences, terraces, etc.

³ Total cost of producing cotton.

Source: Unpublished data from 1969 Cost of Producing Upland Cotton Survey.

18.9 percent had direct cost per pound of 15 cents or less and 55.3 percent was produced with direct cost less than 21 cents per pound. Only 3.8 percent of the cotton produced had a direct cost per pound of 39 cents or greater. For Northeast Arkansas, 11.7 percent had direct cost less than 15 cents and 44.2 had direct cost less than 21 cents. Table 2 also shows direct and overhead costs and direct, overhead, and land cost. Similar data for the major cotton producing areas will be available in the report on costs of producing upland cotton in 1969 which will be published soon.

These data show further that the decision about the profitability of cotton varies from producer to producer. If the average figures indicate that cotton is either profitable or unprofitable, there will still be some farmers who will make or lose money growing the crop.

Cotton versus alternative crops. — How closely competitive to cotton, profitwise, are alternative crops which can be produced in an area? A 1971 report gave the variable costs of production for the major crops by areas for the South Central Region.⁶ Data from this report were utilized with average yield estimates and 1971 average prices received by farmers to estimate the average net returns over variable

costs for the various crops (table 3). These returns estimates are for the short run since no charge has been made for overhead or for land. However, since the overhead and land charge should be about the same for two crops if grown on the same acre of land, the long-run consideration would be a lowering of the absolute profit level for each crop but not a change in the rank of the most profitable.

The data in table 3 show that with the assumptions specified, cotton is more profitable than soybeans only in the Delta and Brown Loam areas. Soybeans rank higher than cotton in Northeast Arkansas and become increasingly more profitable in the Clay Hills, Black Belt, and Texas Coastal Prairie. Of the other major crops shown, none can closely compete with cotton or soybeans except for grain sorghum in the two Texas areas. Returns data are not shown for rice or sugar beets which are more profitable than any of these crops. However, since they are still under marketing quotas their expansion is limited.

The 1971 price received for soybeans puts them in a very favorable position. If this price holds, there will probably be an increase in soybean acreage next year. However, the seasonal price of cotton for 1971 is some higher than

⁶ Strickland, P. L., and Harwell, R. Lynn. Selected U.S. Crop Budgets, Yields, Inputs, and Variable Costs. Vol. V, South Central Region, ERS-461, Econ. Res. Serv., USDA. April 1971.

Table 3. Average returns over variable cost¹ per acre for specified crops for specified cotton producing areas. Average yields and 1971 prices

Region	Crop (U.S. average price per unit) ²				
	Cotton (25¢) Lb. of lint	Soybean (\$2.80) Bu.	Corn (\$1.10) Bu.	Sorghum (\$2.00) Cwt.	Wheat (\$1.25) Bu.
Delta					
Yield	650	25	—	—	30
Returns/acre	\$74.86	\$46.38	—	—	\$8.85
Brown loam					
Yield	600	25	55	—	30
Returns/acre	\$55.65	\$31.52	\$ 5.28	—	\$8.60
N. E. Arkansas					
Yield	475	23	48	—	29
Returns/acre	\$33.36	\$35.83	\$16.99	—	\$8.00
Miss. clay hills					
Yield	500	27	60	—	—
Returns/acre	\$33.93	\$37.89	\$22.10	—	—
Miss. black belt					
Yield	420	27	39	—	—
Returns/acre	\$29.66	\$44.97	\$ 3.75	—	—
Texas black prairie					
Yield	225	—	—	22	21
Returns/acre	\$ 1.08	—	—	\$15.50	\$8.01
Texas coastal prairie					
Yield	330	22	—	27	—
Returns/acre	\$11.38	\$33.00	—	\$26.50	—

¹Variable cost data from reference in footnote 6, p. 22.

²Does not include any price support or loan payment.

25 cents. Whether or not this will hold during 1972 is open to question.

In table 3, comparisons have been made of the average profitability of the various crops. Several factors can affect the profitability of these crops. These include price received for cotton and cottonseed, price received for competing crop, yield of cotton and prices paid for inputs. The effect of these factors on cotton and soybeans are examined in table 4. The basic assumption is an acre of cotton in the Delta yielding 720 pounds of lint per acre and with total variable cost of \$121.84 per acre. It is compared with an acre of soybeans yielding 25 bushels per acre and with variable cost of \$23.62 per acre. Cottonseed is sold at \$52 per ton and labor is hired at \$1.50 an hour per acre. The break-even price for cotton, or the price at which the returns over variable cost for an acre of cotton is equal to the returns for an acre of

soybeans, is determined for soybean prices of \$2.60, \$2.80, and \$3.00 per bushel. These same break-even prices are calculated for a cotton yield of 650 pounds, which is about the average for the past several years, and for 560 pounds, which was the average yield in 1969. Other calculations are made assuming a cottonseed price of \$48 per ton and labor prices of \$2.00 and \$2.50 per hour. The various combinations in the table give some idea of the effect of these factors on the profitability of cotton.

At a 650 pound cotton yield and \$2.80 per bushel soybeans, cotton in the Delta would be more profitable than soybeans at any cotton price above 21.7 cents per pound. However, if the cotton yield dropped to 560 pounds, the price would have to be 25.9 cents or better before cotton would be the most profitable crop. Following through the table, comparisons can be made of the effect of changes in the

Table 4. A comparison of the break-even price of cotton with varying assumptions about other factors, Mississippi Delta loam soils, 1971 prices

Soybean price per bushel	Break-even prices, in cents per lb. of lint ¹		
	720 Lb. per acre	650 Lb. per acre	560 Lb. per acre
	Break-even prices (cents per lb. of lint) ¹		
	Cottonseed at \$52 per ton, labor at \$1.50 per hour		
2.60	18.5	21.0	25.0
2.80	19.2	21.7	25.9
3.00	19.9	22.5	26.8
	Cottonseed at \$48 per ton, labor at \$1.50 per hour		
2.60	18.8	21.3	25.3
2.80	19.5	22.0	26.2
3.00	20.2	22.3	27.1
	Cottonseed at \$52 per ton, labor at \$2.00 per hour		
2.60	19.0	21.4	25.6
2.80	19.7	22.2	26.5
3.00	20.4	23.0	27.4
	Cottonseed at \$52 per ton, labor at \$2.50 per hour		
2.60	19.5	22.0	26.3
2.80	20.2	22.8	27.2
3.00	20.9	23.5	28.1

¹Soybean yield of 25 bushels and total variable cost per acre of 23.62. Total variable cost per acre of cotton is 121.84. Break-even price for cotton is determined by adding the return over variable cost for soybeans and the total variable cost for cotton, subtracting the value of the cotton seed sold and dividing by the yield per acre of cotton.

other factors on the break-even price for cotton.

Summary. — This paper has attempted to evaluate the competitive position of cotton by presenting average cost data and average yields and returns. Some attempt was made to show how variations in these factors affect the profit picture of cotton. These average data were used with the full realization that each individual producer has his own cost structure and his own goals and objectives.

When reviewing the results of cotton cost surveys, it becomes fairly obvious that the average cost has been nearly equal to or above the market price of cotton in recent years. Thus, much of the profit in cotton for most regions has been derived from the government payment received. There are some areas, such as the Delta, which can make some profit at the market price. Also, there are some producers in other areas whose yields are high enough or whose cost structures are low enough to make cotton profitable. These producers will have some incentive to increase cotton production above the allotment level for which price supports are paid.

Although cotton from a purely economic point of view seems more profitable than the alternative crops available in some areas, many farmers failed to increase acreage above that re-

quired to receive the cotton payment. Are these farmers acting rationally? They could be. Cotton is a high risk crop. Uncontrolled insects can reduce the crop yield drastically. With a heavy infestation, the cost of control can be high. Cotton is also a labor intensive crop. If labor is scarce or if the farmer desires more leisure, he will likely make a decision to produce a less profitable crop which requires less labor and management time.

This situation may help to explain why soybeans have become so popular in the Delta. They provide a good return per acre, the planting and cultivation required is much less than for cotton, the insect control program is less costly, and harvest requirements are lower.

The outlook for cotton is not altogether rosy. With some type of price support payment, most farmers can make a profit from cotton. However, if farmers received only the free market price, many of them would probably discontinue production. It seems a need exists for a continued research effort on ways to reduce the production costs for cotton. Other efforts to increase the demand and raise the market price are also appropriate. Cotton is not necessarily on the way out, but the time that the industry could sit back and ignore reality is long past.

OVERSEAS MARKETING OPPORTUNITIES FOR COTTONSEED OIL AND MEAL

by
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Since cottonseed is a byproduct of cotton, it is often found in a situation that is not necessarily related to the world oilseed supply demands. Because cottonseed is a byproduct of cotton, a tremendously large demand for cotton may result in an excess supply of cottonseed. Similarly, a sharp reduction in the demand for cotton would also reduce the supply of cottonseed available to the crushing industry. In looking at the overseas opportunities for U.S. cottonseed oil and cottonseed meal, we must look at the total world fats and oils picture and the world protein situation. We must also look at the world demand for cotton fiber, since cottonseed is only one of the many oilseeds consumed around the world. However, because of this peculiarity of the supply being related to the demand for cotton fiber, there are tremendous swings in the prices of cottonseed and cotton products when considered in relation to the supply and demand of other fats and oils.

Generally, we see a much more favorable demand for cottonseed oil than for cottonseed meal. This has been the pattern of recent years, and is especially true this year since cottonseed meal exports have been almost zero. We expect this trend to continue with almost all the cottonseed meal produced in the United States consumed domestically. It is important that we understand why there is little demand for cottonseed meal in the world protein markets.

We see this trend away from exporting cottonseed meal to be primarily the result of two or three factors as follows:

The lack of cheap transportation available to move cottonseed meal to the various ports compared with that for soybean meal is a major reason why cottonseed meal cannot compete in the world markets. The second major factor is the competition that cottonseed meal faces in the world markets from other high fiber oilseed meal. Whereas the major competition of soybean meal is fishmeal, cottonseed meal faces competition from rapeseed meal, linseed meal, sunflower seed meal, and so forth. Cottonseed meal is also limited somewhat by the kind of animals to which it can be fed — livestock.

As the world oilseed supplies of rapeseed and sunflower seed are increasing at a fairly fast rate, the export demand for cottonseed meal has continued to decline. Also, the domestic demand for cottonseed meal has been very good in recent years because of a very favorable livestock economy which has kept cottonseed meal

from being competitive in export markets. That is, when cottonseed meal becomes cheap enough to compete in the export markets, we find there is a greater domestic demand than we are able to meet. Because of these reasons, we do not see much future in the demand for cottonseed meal in overseas markets.

When we look at the demand for cottonseed oil, the situation is much different than that seen in the cottonseed meal economy. Cottonseed oil can be substituted on a one-for-one basis with many other fats and oils consumed in the world. In a number of markets, cottonseed oil is the preferred oil, and we think it will continue to demand a relatively high price as compared with soybean oil and sunoil. For example, we believe that the United Arab Republic (UAR) will continue to buy cottonseed oil as long as the Prime Bleachable Summer Yellow (PBSY) is no more than \$40.00 a ton premium to sunoil. The recent granting of General Sales Manager (GSM-4) credits to the UAR in relation to the amount they repay will be a major benefit in gaining a market of cottonseed oil in that country. We also continue to see a relatively large demand for cottonseed oil in most Western European countries, especially in the United Kingdom. Exports of cottonseed oil have jumped drastically in the last few years as the supply of groundnut oil and sunoil have been reduced. In the crop year 1966 and 1967, U.S. exports of cottonseed oil were almost nonexistent. The primary reason for this lack of cottonseed oil was due to the tremendous supply of groundnut oil and sunoil. For example, we estimate that in 1972 the amount of groundnut oil and sunoil available to world markets is only 63 percent of that available in 1967. A major portion of this reduction in these two premium oils has been offset by an increase in exports of U.S. cottonseed oil.

What is in store for cottonseed and cottonseed products during 1972-73?

The January 27 planting intentions published by the U.S. Department of Agriculture (USDA) indicates that the U.S. farmer intends to plant about 13.2 million acres in 1972. However, we feel that as a result of the Feed Grain Program announced last week, a substantial increase in cotton acreage will be seen in Texas and Oklahoma. Because of this anticipated increase and extremely favorable prices now being paid for the new crop cotton, we think farmers will plant about 13.7 million acres

of cotton in 1972. Assuming a decent yield of cotton, although nothing near the record of a few years ago, we believe that a 12-million-bale estimate is realistic. This compares with our estimate in 1971 of slightly over 10 million bales.

In 1971-72 we are estimating the cottonseed crush at about 3.8 million tons. If we achieve our estimate of a 12-million-bale crop, we think the cottonseed crush in 1972-73 will increase to about 4.6 million tons or a 19 percent increase from our current year's estimate. This large crush would produce about 270 million more pounds of cottonseed oil and 350 thousand tons more cottonseed meal.

If we obtain these larger supplies of cottonseed oil, which would be the largest productions since 1965-66, we would expect cottonseed oil and cottonseed meal to sell at a much smaller premium to soybean oil than has been experienced in the past few years. However, our export outlet will possibly be influenced more by the supply of groundnuts available from North Africa and sunflower seeds available from Eastern Europe than the soybean supply in the U.S.

Looking ahead to 1972-73 and assuming a somewhat normal oilseed crop year in the world, one must conclude that the oil shortage we have seen since 1969 is rapidly coming to an end. Palm oil supplies continue to increase, rapeseed available for crushing will be substantially larger than the current year, and supplies of groundnut and sunflowerseeds should increase in 1972-73. Based on the recent announcements concerning the Feed Grain Program, we would expect soybean products to increase about 120 million bushels in 1972-73.

The current prices of hogs and corn will probably result in a major turn-around in the pig crop year, which should put more lard into the

fats and oils market during 1973 as compared with 1972.

Also, the per capita consumption of fats and oils in the United States seems to be at a saturation point, with the only increase foreseen in the next 1 to 2 years due to the population growth or about 1 1/2 percent per year.

As the demand for protein continues to grow, it does look as though we are moving into a period of a somewhat lower fats and oils price than we have seen in recent years. We will probably see a somewhat lower premium for high quality oils than have been seen in the last 2 or 3 years, relative to soybean oil.

Unless we have a large donation program to the Asian area, there may be a problem finding a home for the oil production in the United States in 1972-73. However, looking at a much nearer term picture, between now and the fall of 1972, the outlook for fats and oils is much more favorable. Lard production and yields per 100 pounds of pork continues to decline very sharply. The supply of beans will force a sharp reduction in crushings in the spring and summer, and this in turn will result in a reduction in soybean oil supplies. Also, the smaller cottonseed crop will limit the amount of cottonseed oil available, and the supplies of groundnut oil and sunflowerseed oil will not be nearly as burdensome as people believed in a few months ago.

Taking an overall look at these factors, we think the demand for cottonseed oil during the coming months, both domestically and abroad, will be quite favorable. Perhaps the real key to what will happen to the remainder of the 1971-72 crop year will be the ability of USDA to program P.L. 480's to India, Pakistan, and Bangla-Desh, and to other oil deficit areas. Certainly USDA is making every effort to find a home for soybean oil.

HEALTH AND SAFETY STANDARDS IN OIL MILL OPERATIONS

by

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On-the-job accidents last year took 14,000 lives and injured another 2,200,000 at an estimated cost of \$10 billion. As I considered how best to set out the Health and Safety Standards in oil mill operations and how to give as much information as possible concerning compliance and information pertinent to the Occupational Safety and Health Act as it stands today, I thought we should conduct a hypothetical oil mill inspection by a Compliance Safety and Health Officer (CSHO) of the United States Department of Labor.

The CSHO's responsibilities are extensive, the primary responsibility being to conduct an effective inspection to determine whether the employer is (1) complying with Safety and Health standards and regulations of the act, and (2) furnishing places of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees.

The conduction of an effective inspection requires identification, professional evaluation, and accurate reporting of Safety and Health

conditions and practices in the operating scope of the individual plant.

Because of manpower resources, the Occupational Safety and Health Administration (OSHA) has found it necessary to set up priorities to accomplish its goal: The following priorities are set forth in the Compliance Manual:

1. Catastrophe and/or fatality.
 2. Complaints of employees which are found to be of a nature which would require inspection of an installation.
 3. Target industry.
 4. General inspection and related activities.
- At the present time, the following are target industries:

1. Longshoring.
2. Lumber and wood products.
3. Roofing and sheet metal.
4. Meat and meat products.
5. Mobile homes and other transportation equipment.

The Department has tried to set out a percentage of their time which will be spent in inspecting the following priority groups.

1. Catastrophe and/or fatality, 10 percent.
2. Complaint — serious or other, 30 percent.
3. Target industry, 35 percent.
4. General inspection and related activities, 25 percent.

It is my understanding at the present time that the majority of the OSHA personnel are spending their time inspecting locations which have had a catastrophe or a fatality.

If your mill has been slated for an inspection because of a catastrophe or a death, you would be aware that the inspection was pending. For an employee complaint, you would not necessarily be aware of the fact that you were going to be inspected unless the inspector deemed it necessary to give advance notice for a specific reason. This brings up an important factor in your operation — employee relations. The relationship between your supervising personnel and the individual employee in the mill will, in the future, probably have a great deal to do with your association with the OSHA.

If the employee has a rational and reasonable complaint, hear it first.

Another thing that will have a great deal to do with your situation at the time of an inspection will be the good faith of your concern. When I say good faith, I take into consideration a number of factors:

1. your attitude when the inspector appears at your plant, and
2. the physical programs that you have set up to comply with the act which is in the general duty clause of the act requiring you to give your employees a place to work which is free from all hazards which could be causing or would cause his death.

Before the OSHA inspector appears on the scene, it is required that he review the standards which he feels applicable to the oil mill type of operation. At the present time, he doesn't have too much case history on which to establish a pattern of operation for our industry, but as each day passes, he is becoming more proficient in grading the installations which he inspects.

The inspection shall be made, without advance notice, during regular working hours.

1. In cases of apparent imminent danger, ad

1. In cases of apparent imminent danger, advance notice would enable the employer to abate the danger as quickly as possible;
2. If inspection can most effectively be conducted after operating hours; and
3. Where it is necessary to have representatives of all concerned (employer, employee).

There will be an opening conference, at which time the inspector will explain that the purpose of his visit is to investigate and ascertain whether the employer is in compliance with the requirements of the act. He will outline, in general, the terms and scope of the inspection which will cover the physical inspection of the work site and will also include employee interviews. During the opening conference, he will ask that the records pertaining to the act be made available to him — the log of recordable occupational injuries and illnesses, supplemental records, and the annual summary for the establishment. These record forms are 100, 101, and 102.

At the inspection the CSHO will make whatever notes are necessary so that he may fill out OSHA Form 1. These would cover:

1. Violation description,
2. Serious or other and De Minimis,
3. Location in the establishment,
4. Diagrams where required,
5. Photographs if necessary,
6. Interview with employees,
7. Hazards corrected at inspection,
8. Instrument readings on sound levels — health hazards (cotton dust levels),
9. Names of the recognized unions or employee representatives working in the establishment.

We can begin our inspection of the mill in the seed receiving and storage area. As we approach this area, we would hear the pneumatic unloaders operating. The first information that would be required by the inspector would be that of the sound level in this particular area. On checking with his sound meter he would find a sound level of approximately 97 decibels. At the 97 decibel level a man can work for only 3 hours during any one day. Therefore, it is necessary to provide this man with some type of personal safety equipment which will decrease

the intensity during this period of time. As a matter of information, an increase of 10 decibels represents an increase of approximately 300 percent in sound pressure. A decibel reading of 100 is therefore 3 times as intense as a 90 decibel reading. The U.S. Department of Labor has published a bulletin No. 334, titled, "Guidelines to the Department of Labor's Occupational Noise Standards." This publication is your guide in complying with noise abatement. Some excerpts from this publication are as follows: "The use of personal protective equipment is considered by the Department to be an interim measure while engineering and administrative controls are being perfected. There will be very few cases in which the use of this equipment will be acceptable as a permanent solution to the noise problem." It is also necessary to begin a hearing conservation program. All employees working steadily or intermittently in areas having a sound level of 90 decibels or above will be included in this conversation program. This program includes the audiometric testing of individuals on a regular basis to determine the loss of hearing, if any. "The tests are required as frequently as the plant's consulting physician deems necessary, but shall not be, except under very special conditions, less than once a year." The reduction in noise levels can be attained by any number of different pieces of protective equipment.

The ladder leading to the platform on which the unloaders are installed is not standard when the edge of the ladder is more than 12 inches from the landing platform. The ladder should be 16 inches wide, the rungs 12 inches apart and 7 inches out from the wall.

Equipment. — The unloaders are usually placed on the platform as close as possible to each other. This means that there is no passage room between, so the employee climbs over the discharge section which has an open screw conveyor immediately below. The discharge area should be completely guarded by a barrier guard. The drives, either flat belt or chain, should be covered.

Seed house — head house. — As you enter the door of the seed house — head house, you are immediately faced with a ladder which is not standard. The standards require a cage on all ladders that are more than 20 feet high and a platform every 30 feet. The landing opening at the elevator head should be guarded by a standard handrail. All drives in the head house should be guarded.

The pit opening should be guarded by a handrail. If no handrail is used, the hinged door must be guarded by an employee while it is open.

The ladder up the roof of the seed house, beside the drag, is not standard. It should be

replaced by stairs. Only ladders that are installed between a 90° and a 75° angle are considered to be standard. All drives in the monitor are to be guarded. The conveyor should be covered if it is a screw conveyor. A walkover should be provided for a belt drag.

The tunnel area will probably need cleaning and the light guards replaced.

Cooling fan house. — As we enter the cooling fan house area, it probably is not really clean; there is a possibility of water in the pit area. A fan has had a motor changed recently and the electrical contractor did not replace the connection box cover on the motor. A switch box was left open so that the amperage could be checked on the motor while it was operating. A fire extinguisher was left empty after it was used to extinguish a fire in the motor.

Cleaning room. — In the cleaning room, the sand and boll reels will probably be found to have a substandard platform as access to clean the reel. A walkway shall be at least 18 inches wide and have standard handrails. If it is more than 4 feet from the floor, it shall have a standard, 4-inch toeboard and it should have no more than 1-inch openings in the floor grillwork.

The white seed bin fluted feeder is operating without a barrier guard. Located immediately below the feeder chute is an open screw conveyor which should have an internal safety grill bolted inside.

The Bauer Seed Cleaner needs a safety grill over the front. There is a fluted feeder above and a screw conveyor below the manufacturer's barrier grill, which is not sufficient. All drives should be guarded. Any conveyor should have an internal barrier guard where there is a hinged feed-in opening.

Lint room. — As the lint room is entered, the first thing the inspector would probably notice is an employee using an air hose for cleaning. The pressure is found to be above the 30 p.s.i. limit. This requirement is met by a special nozzle arrangement to insure that the pressure is not exceeded.

All of the linters are driven from group drives, either the M drive or the J drive. It is, in my estimation, impossible to guard a group drive. The answer is an individual drive with the proper guards on each linter.

All drives below 7 feet from the floor must be guarded. The fan platforms overhead have no handrails or toeboards. The lighting in the room is not sufficient for safe operation.

An overhead walkway is available for placing belts on pulleys on a line shaft. All pulleys next to the walkway should be guarded by a barrier. The pulleys and belts just mentioned, even though they are over 7 feet above the floor, if over a passageway, will fall into the following categories:

1. Belt traveling at 1,800 f.p.m.,
2. Center to center shaft distance is 10 feet or more,
3. Belt is 8 inches or more in width.

All flat belts in these classifications have to be guarded. When a shaft passes through a walkway, it requires a tubular guard for the shaft. Again, in checking the sound level on the area, the inspector would find a level of approximately 100 decibels. The area is dusty and the men are not using the Bureau of Mines approved dust masks.

Separating room. — In the separating room, we find that all equipment is driven from an overhead line shaft. The individual shaker drives for the hullers are not guarded. A shaft projects several inches from one back shaft bearing and there is a keyway in the shaft. A shaft cannot project more than one-half of its diameter. If a keyway is necessary to the operation, it has to be filled and smoothed out or guarded.

The gears on the following equipment are not guarded:

1. Huller feeders,
2. Clutch drive on H&S machines,
3. Clutch drive on purifier shaker,
4. Gears on the double drum beater.

All gears, regardless of where they are located, must be guarded.

Press room. — An open electrical switch is noted because of the heat in the area. They are left open to keep them cool. One employee is seen working on the cooker sweeps inside the cooker. The inspector checked for electrical lockouts and found none in use. All equipment must be locked out by a padlock. The lock should have only one key, and that key should be in the possession of the individual who is working on the equipment. If two or more individuals are working on a piece of equipment, each should lock out the safety switch when the equipment is being repaired.

The aid compressor does not have a lever operated pop-off valve nor does it have a pressure gauge on the compressor tank. Main drives and intermediate drives are not guarded on the rolls. Access stairs to roll platforms do not have handrails or rails around the platforms. The sound level at the rolls is 95 decibels due to the poor mechanical condition of the chills and bearing stands. If the units are in good repair, the level should be about 87 decibels.

Meal room. — Cleanliness has always been hard to control in the meal room. There are large accumulations of meal dust which can be an extreme hazard under certain conditions of humidity, percentage in the atmosphere, and the spark.

Solvent extraction plant. — The solvent extraction area will normally be the best looking area in your plant. The plant is checked for

grounding of all equipment. The emergency breathing apparatus is checked and found in excellent condition.

Bath and locker areas. — Bath and locker areas are noted offenders. The inspector finds the area unclean and in poor condition. The toilet stools are not partitioned off into separate compartments. The water heater is found to have no safety valve and therefore to be dangerous. A gas heating unit is found to have no vent.

Shop area. — The shop area is cluttered with junk and pieces of equipment supposedly too good to destroy. The electric welding equipment has a spliced lead-in cable. The answer to this is that all extension cords or cables must be one continuous length. The pedestal grinder has three problems:

1. Spindle nuts not guarded,
2. Tool rests not properly spaced to the emery wheel,
3. Eyeshields not on the unit.

Oxygen and acetylene cylinders are stored together. They should be chained or secured against the wall at least 20 feet apart, not near an exit area. All of the 110 volt outlet fixtures are not grounded. One hand drill is not furnished with a three-wire, grounded connection.

In the closing conference the inspector will go over the areas in which a citation will probably be given. He will indicate where you have shown good faith by abating points of criticism during the inspection. He will also fix a reasonable time for abatement of hazards. You may receive a reduction in penalties for different reasons:

1. Up to 20 percent for good faith,
2. 20 Percent for an effective safety program or 10 percent for an average safety program,
3. 5 Percent for plants employing 20 to 100 people.

The possible penalties can be reduced as much as 50 percent.

Compliance Operations Manual

Several of the items in this report are taken directly from the Compliance Operations Manual. As information to you, I would like to quote what is said about violations.

General duty requirements:

Where there are no promulgated standards — The employer “shall furnish to each of his employees employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.”

Serious violations:

“... a serious violation shall be deemed to exist in a place of employment if there is a substantial probability that death or serious physical harm could result from a condition

which exists, . . .”

Nonserious:

“This type of citation shall be issued in situations where an incident or occupational illness resulting from violation of a standard would probably not cause death or serious physical harm but which have a direct or immediate relationship to the safety or health of employees.” For example, lack of guardrail at height from which fall would result in only a sprain or broken leg.

De Minimis:

“No citation — no immediate or direct relationship to safety or health.”

Willful:

“... that the employer committed an intentional and knowing violation of the Act and the employer is conscious of the fact that what he is

doing constitutes a violation of the Act, or even though the employer was not consciously violating the Act, he was aware that a hazardous condition existed and made no reasonable effort to eliminate the condition.”

Repeated:

“A repeated violation differs from a failure to abate in that repeated violations exist where the employer has abated an earlier violation and, upon later inspection, is found to have violated the same standard.”

Imminent danger:

“Any conditions or practices in any place of employment which are such that a danger exists which could reasonably be expected to cause death or serious physical harm immediately or before the imminence of such danger can be eliminated. . .”

CONTROL OF MICROBIOLOGICAL CONTAMINATION IN OILSEED PROCESSING

by

James J. Spadaro, H. H. Mottern, R. Mayne and A. S. Gallo

Southern Marketing and Nutrition Research Division

New Orleans, La.

(Presented by James J. Spadaro)

A knowledge of microbial contamination and its control in cottonseed processing is needed today primarily because of the potential production of cottonseed flour as a protein food for human consumption. One objective of the study was to determine the effects of processing conditions used in cottonseed oil mills on the microbial population and on salmonellae, if present. A second objective was to determine processing conditions necessary for producing cottonseed products free of salmonellae and low in microbial population.

Microbiological studies can be very complex, but the results I am going to show are such that all of us can understand.

You will obtain the following four important results from this presentation:

1. An overall picture of the microbial population that can exist in an oil mill, that is, in a mill operating “as is” for production of meal for feed use and not for food.

2. The fact that whole meats contain appreciably lower total bacteria count than that present in the original seed. This is important since it is anticipated that whole meats will be used in plants contemplating production of food flour.

3. There are processing steps in oil mills that reduce microbiological contamination to a very low acceptable level.

4. Recontamination can occur.

Studies were made in three types of cottonseed oil mills — screw press solvent extraction,

and direct solvent extraction. Samples were taken throughout the processing operations starting with the fuzzy seed and ending with the final ground meal. For example, in a screw press plant samples included delinted seed, whole meats, cracked meats, fine meats, flakes, feed to the cooker, feed to the press, hot press cake, cooled meal, and ground meal after addition of fine hulls. Similarly, applicable samples were taken in prepress solvent extraction and direct solvent extraction plants. In most instances, a series of three or four samples representing each processing operation were taken at each mill at 1-hour intervals. Each sample intended for microbiological analyses was placed in a sanitary carton which was then sealed with tape and placed in polyethylene bags which were also sealed. As soon as possible samples were airmailed to the analytical laboratory. Samples intended for analyses such as moisture and lipids were packaged directly in polyethylene bags.

Microbiological data obtained included total plate count, yeasts, molds, coliforms, fecal coliforms confirmed *Escherichia coli* and the presence or absence of salmonellae.

Results showed that the total plate counts of the fuzzy seed sample were high and varied appreciably even within the same mill. For example, a variation of 15 to 40 million was found in the fuzzy seed from the screw press plant and 160 thousand to 15 million in that from a solvent extraction plant. Total plate counts of the whole meats were appreciably

lower than the fuzzy seed, indicating that a large proportion of the bacteria are present in the linters and hull fractions. This is further shown by the higher total plate counts in the fine meats and mixed meats. These higher plate counts are carried through to the flake feed, to the screw press, or to the solvent extractor.

One of the most significant results noted in this study is that the cooking, pressing, and desolventization operations reduce the total plate counts to a very low and acceptable range — that is, 2,600 to 15,000 in the solvent plant, 20 to 900 in the press plant, and less than 10 in the screw press plant.

Similarly the yeasts, molds, coliforms, and E. coli, which varied appreciably and were high in many cases, were all reduced — the yeasts and molds to less than 10 and the coliforms and E. coli to 0. Yeasts were as high as 700, molds up to 100,000, and coliform over 2,400 before the cooking or desolventization operations.

Salmonellae were found in two samples — one in mixed meats and one in extractor feed. The salmonellae was eliminated in subsequent operations, that is, cooking in one case and desolventization in the other.

Recontamination can and did occur. In the screw press plant where the hot press cake contained negligible amounts of microbiological organisms, the cooled meal showed some increase and the final ground meal showed a tremendous increase. For example, one final

meal had total plate counts of 450,000 to 7 million, yeasts 10 to 20, molds 110 to 2,000, fecal coliform 0.9 to 9.3, coliform over 2,400, and E. coli 0.9 to 9.3. Also, of four samples taken, one showed the presence of salmonellae. The increase in these organisms is due primarily to the addition of unheated hulls and to some extent by the method of handling. Except for the salmonellae, similar recontamination was noted in the prepress solvent extraction plant and in the direct solvent extraction plant.

These studies show that, in practically all cases, the organisms present in cottonseed are killed or appreciably reduced in (1) the cooking operations of a screw press oil mill and of a prepress solvent extraction oil mill, and (2) in the desolventization operation of the direct solvent extraction oil mill. In two cases where salmonellae were found, the organism was killed in the cooking operation and in the desolventization operation; and, if present, it would have been killed under the conditions encountered in the prepress solvent extraction plant. Recontamination can occur, primarily because of the addition of unheated hulls and to method of handling.

It is felt that appreciably more work is required to obtain a more complete picture of microbial contamination and its control in cottonseed oil mills. The above results are based on a study conducted only one day in each of the three oil mills.

AIR, GOOD AND BAD

by

Lyle O. Hill

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ABSTRACT

This report stresses the importance of the need for food processors to face the fact that the Clean Air Act of 1970 means clean process air in 1972. State pollution control authorities have been compiling figures on bad air for the past 3 or 4 years. The inventory which has been compiled was a requirement of the Clean Air Act of 1963. All point sources of air pollution were required to be registered. This information has been fed into computers as it was reported

and is being studied and totaled.

EPA and State authorities know the problem and what is being done about it. The Clean Air Act requirement is a must. State authorities are required by EPA to have submitted a plan of implementation by now. This means good air in 1972 from all point sources, which is now. The urgency of work to solve the problem at every level is emphasized.

AERATION SYSTEM DESIGNS AND STUDIES OF COTTONSEED IN COMMERCIAL STORAGES

by

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The cooling of cottonseed by moving air through it has been practiced for many years to help preserve or maintain the quality of the cottonseed while it was in storage. Many factors can contribute to quality loss. Two of these factors, familiar to all of us, are the seed moisture content and the stored seed temperature. If either one is too high, quality losses can result. Generally, cottonseed will go into storage at 12- to 13-percent moisture. If it is higher than that, the storage problems become more evident. However, research information available indicates that if rapid or progressive cooling can take place, lowering the seed temperature to 50° to 70° F., good seed quality maintenance can be expected.

Despite the fact that cottonseed aeration has been practiced for many years, very few warehousemen know how much air they are moving through the cottonseed. I suppose nobody really knew how much air movement was necessary for satisfactory storage conditions. Some operators are getting by with no trouble or very little. Maybe they are the lucky ones. Other operators are not so fortunate. Probably in many cases the improper design of the air moving system causing poor airflow distribution is a main contributor to unsatisfactory results. We have learned that good storage conditions can be accomplished with relatively small amounts of air movement. However, it is very important that this airflow be uniformly distributed through the cottonseed mass.

Some of the early research work with cottonseed aeration systems was done in small storages, from 450 to 2,400 tons capacity. These included both flat storage and the muskoguee-type storage. In many of these storages, the pallet is used for what we refer to as the aeration duct. Most of these pallets are too small and do not have enough surface area for allowing the air to move from the cottonseed into the pipes that carry the air to the fans. Many of these air-carrying pipes are also too small. At these restricted airflow areas, the increased air velocity causes increased static pressure. As the static pressure increases, the power requirements also increase, many times with no increase in air

movement. Table 1 gives an indication of the increased power requirements when the static pressure is increased. Researchers feel that as much as 25 to 75 percent of the power input is wasted to overcome excess static pressures. In a properly designed system, no more than 10 percent of the power should be used to move air through the system. Then 90 percent of the power is available to move air through the cottonseed.

Table 1. Resistance of cottonseed to airflow at specified rates of flow and depths of seed in level storage

Depth of cottonseed	Airflow rate	Static pressure	Power requirement per 1,000 tons
<u>Ft.</u>	<u>C.f.m./ton</u>	<u>Inches water</u>	<u>Horespower</u>
20	5	2.75	3.50
	10	6.40	19.00
	15	10.60	43.00
30	5	6.50	10.00
	10	15.75	42.50
	15	26.50	100.00
40	5	12.25	17.00
	10	30.50	86.00
	15	52.50	210.00

Figure 1 illustrates how the air must converge to enter the small openings around the pallets. As it converges at these points, the velocity of the air increases in the seed near the pallet and in turn increases the static pressure. Research results indicate that when the air velocity in the cottonseed is increased from 10 to 20 feet per minute, the static pressure is nearly doubled in cottonseed depths of 20 feet.

With a properly designed aeration duct having sufficient surface area, velocities in the seed surrounding the duct can be held within the generally recommended limits of 10 to 20 feet per minute. Adequate duct surface areas can be obtained by various means. Half-round or round

¹ In cooperation with Mississippi Agricultural and Forestry Experiment Station, Delta Branch, Stoneville, Miss.

WOOD PALLET OPEN AREA 1.37 SQ. FT.

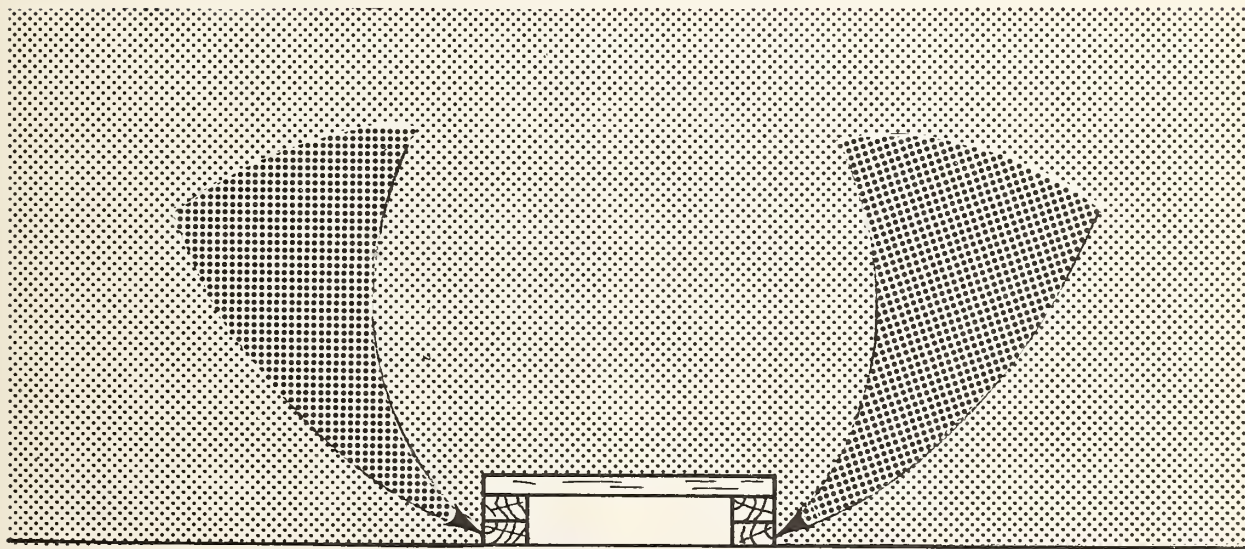
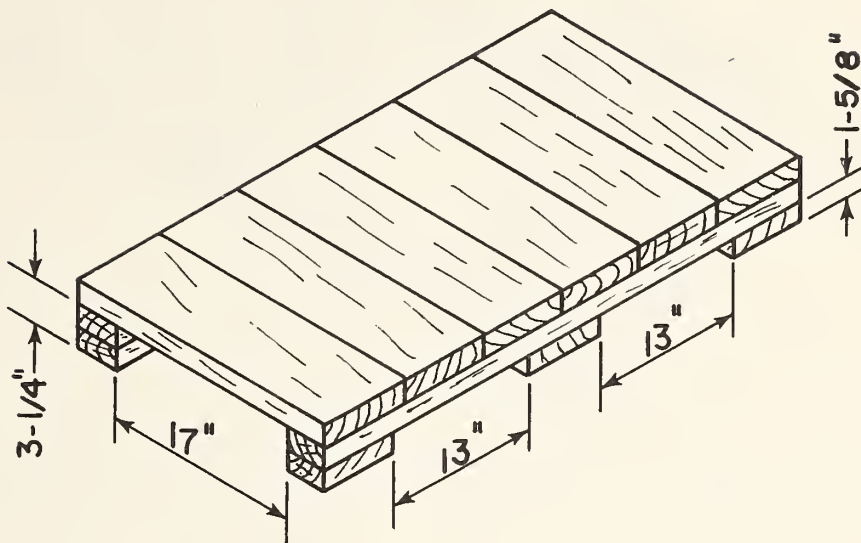


Figure 1. Pallets with narrow openings increase the resistance to airflow; therefore, more power is needed to aerate the cottonseed

ducts on the floor, perforated metal covered tunnel walls, or other designs with openings uniformly spaced over the entire surface area are some of the designs used.

Figure 2 shows a half-round duct with openings where air can enter over the entire

surface, instead of through restricted areas as shown in figure 1. Ducts can be designed with sufficient perimeter and length to provide the necessary surface area, once the amount of air each duct is required to carry is known.

Following are a few examples of improved

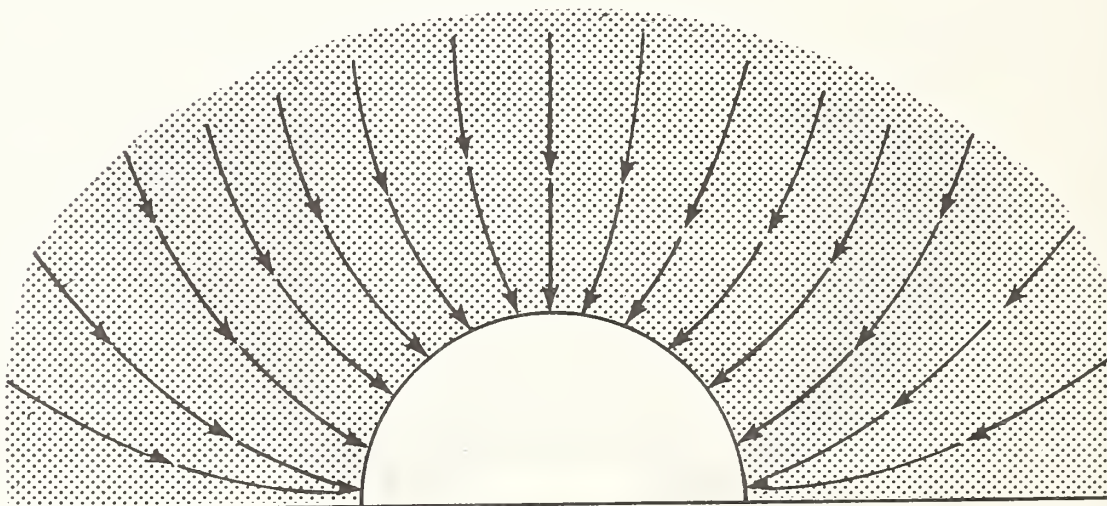
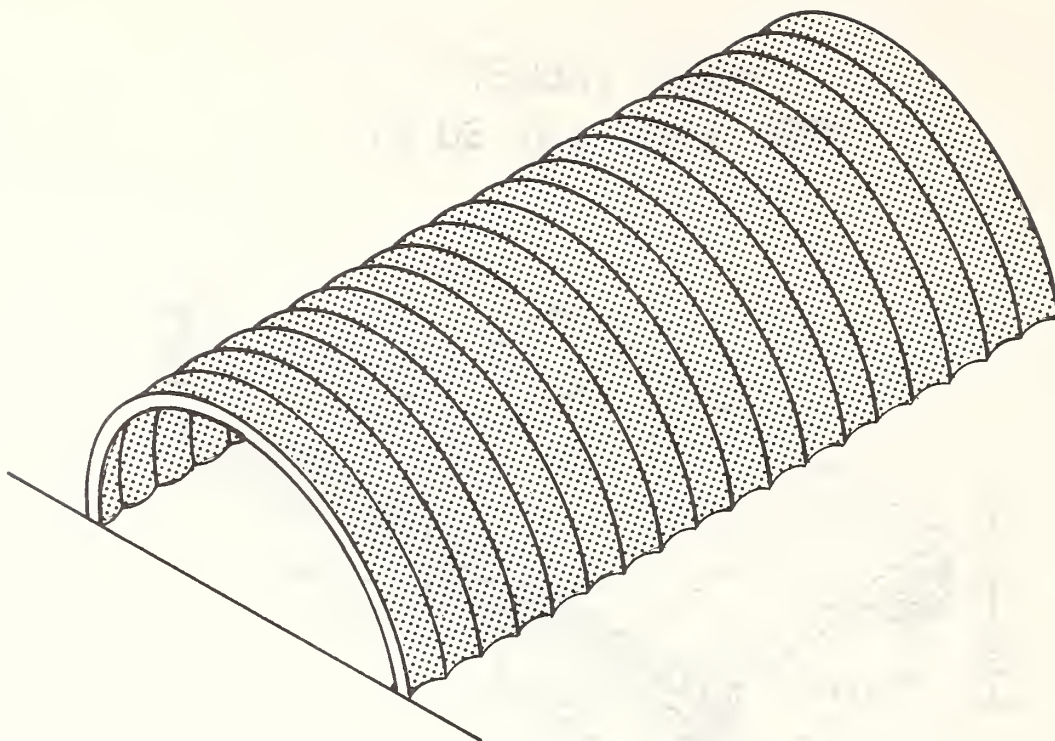


Figure 2. The use of semicircular ducts with a large surface area and uniformly spaced openings results in minimum airflow resistance

aeration systems where our research results were applied. In a small storage with wood pallets on the floor covering openings to underground pipes, a 40-horsepower motor was used to aerate approximately 400 tons of cottonseed. The next season, improved aeration ducts of an experi-

mental design were installed. The original fan and motor were replaced by an industrial exhauster type blower and a 10-horsepower motor. With the experimental system, approximately 600 tons of cottonseed were aerated at a slightly increased airflow rate, about 5.7 cubic feet per

minute (c.f.m.) per ton, but with the 10 horsepower motor. Aeration costs were reduced by using the smaller motor and reducing the fan operating time. The fan operation was controlled by a thermostat and a humidistat to start and stop the motor. Fifty percent more cottonseed was aerated at a slightly higher rate of airflow with less than one-fourth the horsepower previously used.

In another storage with a capacity of approximately 2,400 tons, a 75-horsepower motor was being used. For aeration ducts, this system used wood pallets on the floor that covered openings into pipes leading to the fan. One drawback of this system was that such high static pressures were developed that only about 175 to 200 tons of seed could be aerated at any one time. A rotation method had to be used to aerate the entire storage. Many hot spots developed between periods of aeration. An experimental system was designed and installed in half of this storage. The unloading tunnel through the center of the building, lengthwise, was used as the supply pipe leading to the fan. Short aeration ducts of sufficient size were equally spaced and connected to the tunnel on each side. An industrial exhaustor type blower and 7-1/2-horsepower motor were used with the system. When the 1,150 to 1,200 tons of cottonseed in half of the building was aerated, the airflow rate was approximately 4 c.f.m. per ton. The average temperature of the cottonseed in late September was 95° to 100° F. After 90 hours of fan operation, this average temperature was reduced to 72° F. By late December, 725 hours of fan operation had reduced the average cottonseed temperature to 56° F.

In still another storage, 52 feet wide by 200 feet long, filled with cottonseed to a depth of 22 to 25 feet, and of the same construction as the example given just above, the unloading tunnel was revamped and used as the only aeration duct. Part of the tunnel wall was removed and replaced with hardware cloth. The tunnel was divided into sections with bulkhead doors. Supply pipes were installed to provide aeration in selected parts of the storage at any one time. Two low static pressure (6 inches maximum) fans were used, one at each end of the tunnel. The system was capable of aerating the entire storage (2,400 tons) at one time, or in any combination of quarter sections of the storage. Each of the fans was driven by a 7 1/2-horsepower motor. With the improvements made to the aeration system in this storage, 2,400 tons of cottonseed can be aerated with two 7 1/2-horsepower motors. The old system could only accommodate about 175 to 200 tons at any one time with a 75-horsepower motor and fan.

Aeration systems in muskogee-type storages are somewhat more difficult to design because of differences in cottonseed depths within the

storage. However, systems have been designed, installed, and tested, and they have proven to be satisfactory.

Research studies have been conducted in a large muskogee storage, 150 feet by 160 feet with a capacity for approximately 14,000 tons of cottonseed. Originally the tunnel was being used as the aeration duct with some additional pallets on the floor spaced out some distance from and connected to the tunnel. Preliminary observations indicated that the pallets were placed out under the shallower depths of cottonseed and that the openings along the lower edge of the tunnel walls did not provide enough duct surface open area. Velocity of the air through the cottonseed near the tunnel was estimated to be near 50 feet per minute. This is considerably above the recommended velocity of 10 to 20 feet per minute. Additional duct surface open area was provided by placing pallets constructed of two by fours and two by sixes against the tunnel walls. This nearly tripled the effective duct surface area of the tunnel. Other recommendations to improve the system were to seal about 30 feet of each end of the tunnel to prevent any air movement, as shown in figure 3. This was done to eliminate short circuiting of the air through the shallower depths of cottonseed. The pallets along the tunnel on the floor have now been completely omitted from the system. The only aeration duct in this storage is the center 100 feet of the tunnel. This system uses two large fans, each driven by a 75-horsepower motor.

Last storage season, with judicious operation of the fan using only the most advantageous outside air for cooling, some 200,000 horsepower-hours of electricity were saved over the previous season. At a cost of two cents per kilowatt-hour, this amounts to approximately \$4,000 saving last year.

Other muskogee-type storages for which we have given recommendations use only the unloading tunnel for aeration ducts. In one case the open area of the tunnel walls has been increased by cutting out part of the tunnel covering. These openings have been covered with a heavy gage expanded metal with 2- by 5-inch openings. In another case, where a new tunnel was installed in a storage expansion project, the tunnel sections provided by the manufacturer were covered with approximately the same type of expanded metal.

Every aeration system installation has its own individual design problems. Before designing a system and selecting aeration equipment, the following factors should be considered: (1) the size and type of structure in which the system is to be installed, (2) the depths of the cottonseed through which the air will be moved, (3) the airflow rate per ton of seed to be

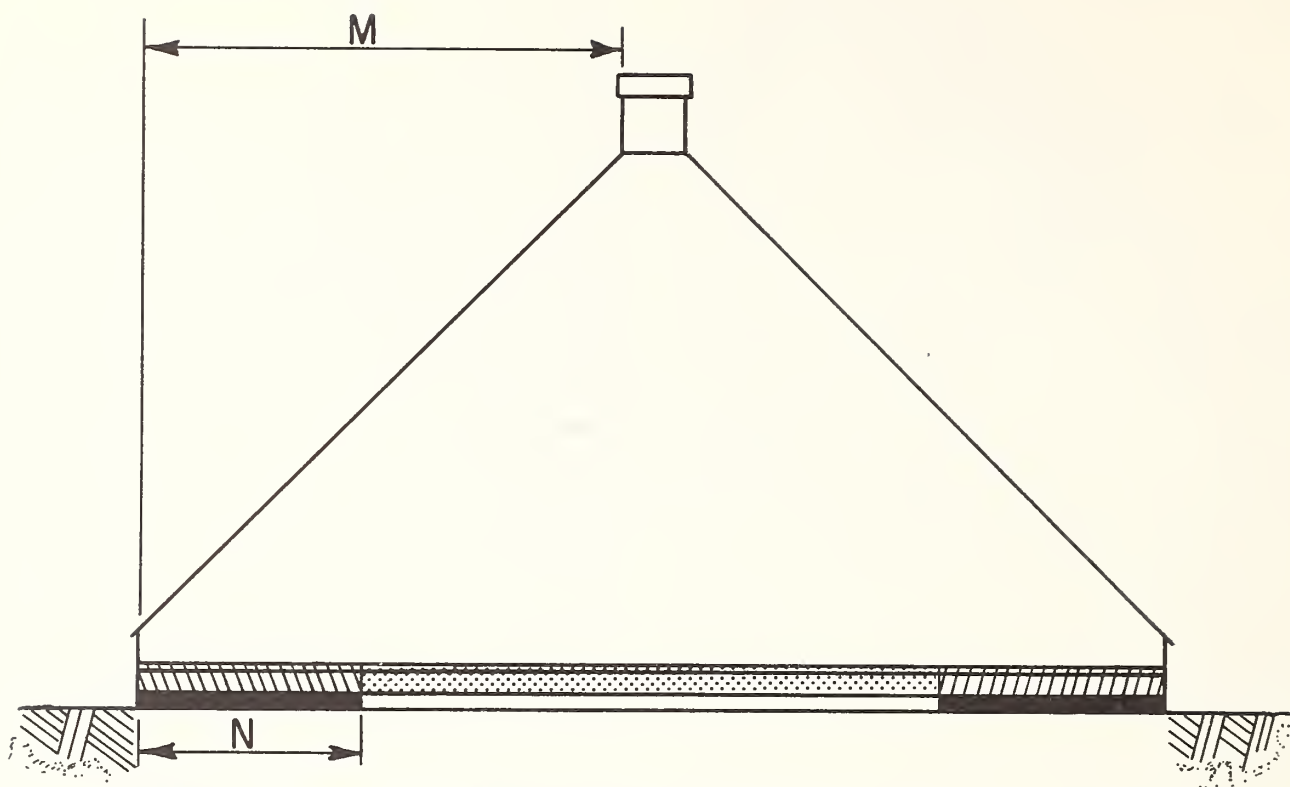


Figure 3. In pyramidal type storages 45 to 50 percent of the horizontal distance of the roof slope determines the minimum amount of the tunnel wall to be sealed against all air movement. M is horizontal distance of roof slope; N is length of tunnel to be covered; and N is 45 to 50 percent of M

provided, and (4) the quantity of cottonseed to be served by each fan. After these points have been considered, determinations should be made for: (1) total air volume to be supplied, (2) the static pressure against which the fan or fans must operate, (3) the size and type of fans and motors needed, and (4) the kinds of aeration ducts and supply pipes needed.

In making recommendations, we seldom suggest an airflow rate above 10 c.f.m. per ton and suggest this amount only for aerating cottonseed for planting purposes. In large muskoguee-type storages with cottonseed depths of 80 to 100 feet, airflow rates are usually limited to not more than 2 c.f.m. per ton of seed. At this airflow rate through 80 feet of cottonseed, the static pressure is around 20 inches water gage. This is about the upper limit of static pressure for most exhaustor-type fans. Moving air at static pressures above 20 inches requires a high pressure blower-type fan.

After a practical airflow rate and static pressure have been selected in designing an aeration system, the aeration duct size is determined by using an air velocity at the duct surface of 10 feet per minute. In large, deep storages with higher total static pressures this air

velocity rate may be increased to 15 feet per minute. Very seldom do we use an air velocity as much as 20 feet per minute at the duct surface.

Airflow rates, static pressures, and horsepower requirements for designing aeration systems are given in figures 4 and 5. For example, let us consider a storage having a cottonseed depth of 40 feet. Choose an airflow rate of 5 c.f.m. per ton. Following the 40 feet depth line vertically to the intersection of the 5 c.f.m. curve and then horizontally to the left margin, we find the static pressure to be approximately 12.2 inches of water. Again, following the 40-foot depth line vertically to the 5 c.f.m. curve, we find the power requirement to be approximately 1.7 horsepower per 100 tons of seed.

In another example, let us consider a storage with a cottonseed depth of 75 feet. At an airflow rate of 2 c.f.m. per ton, we find that moving to the left margin from the intersection of these two lines that the static pressure is approximately 17.5 inches of water. We also find that the power requirements for these conditions is approximately 1.0 horsepower per 100 tons of seed. Consider increasing the airflow rate to 3.5 c.f.m. per ton. At 75 feet deep, the

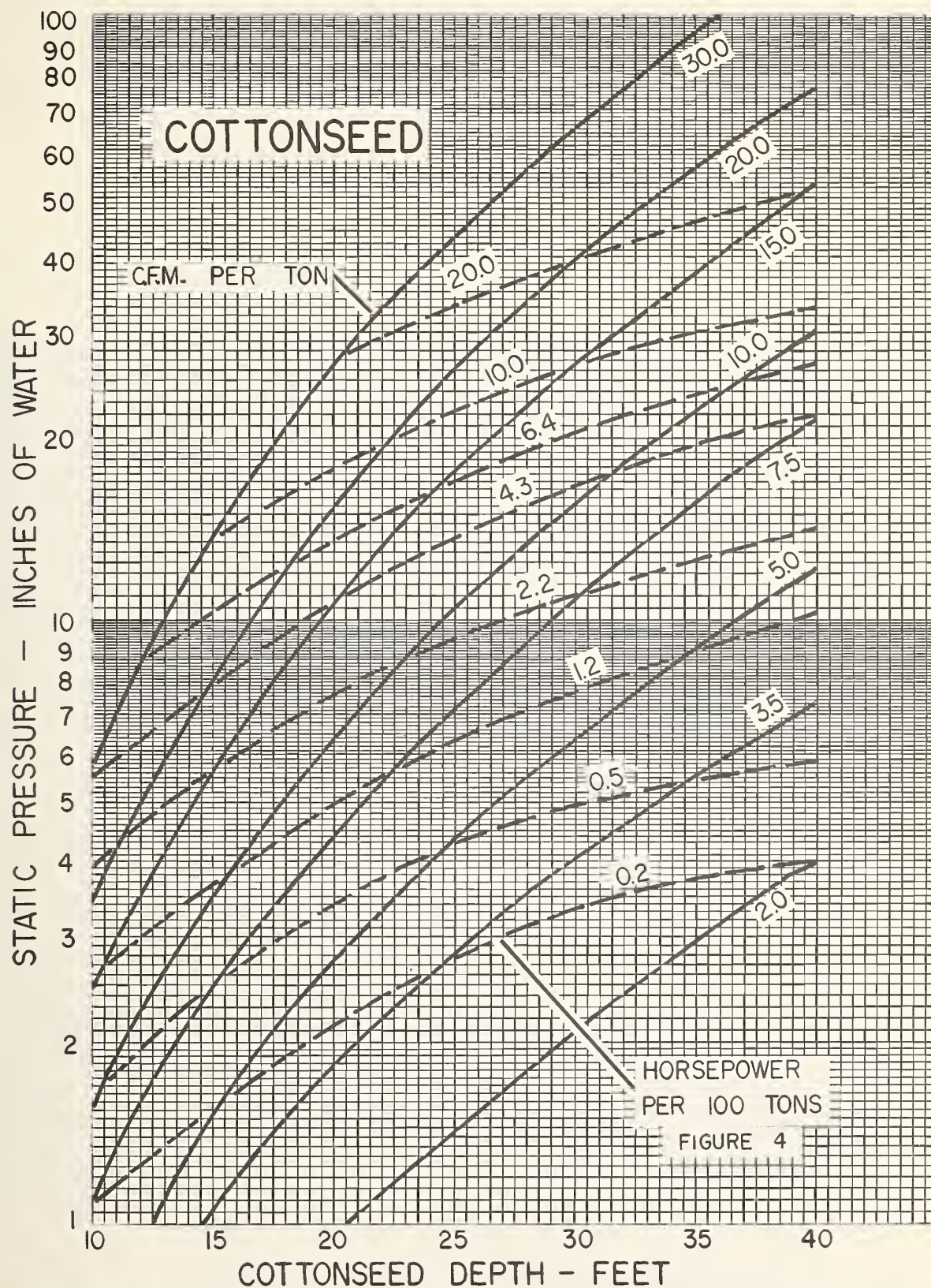


Figure 4. Fan horsepower and static pressure (inches of water) requirements for aerating cottonseed at different rates of airflow (c.f.m. per ton) and at cottonseed depths ranging from 10 to 40 feet.

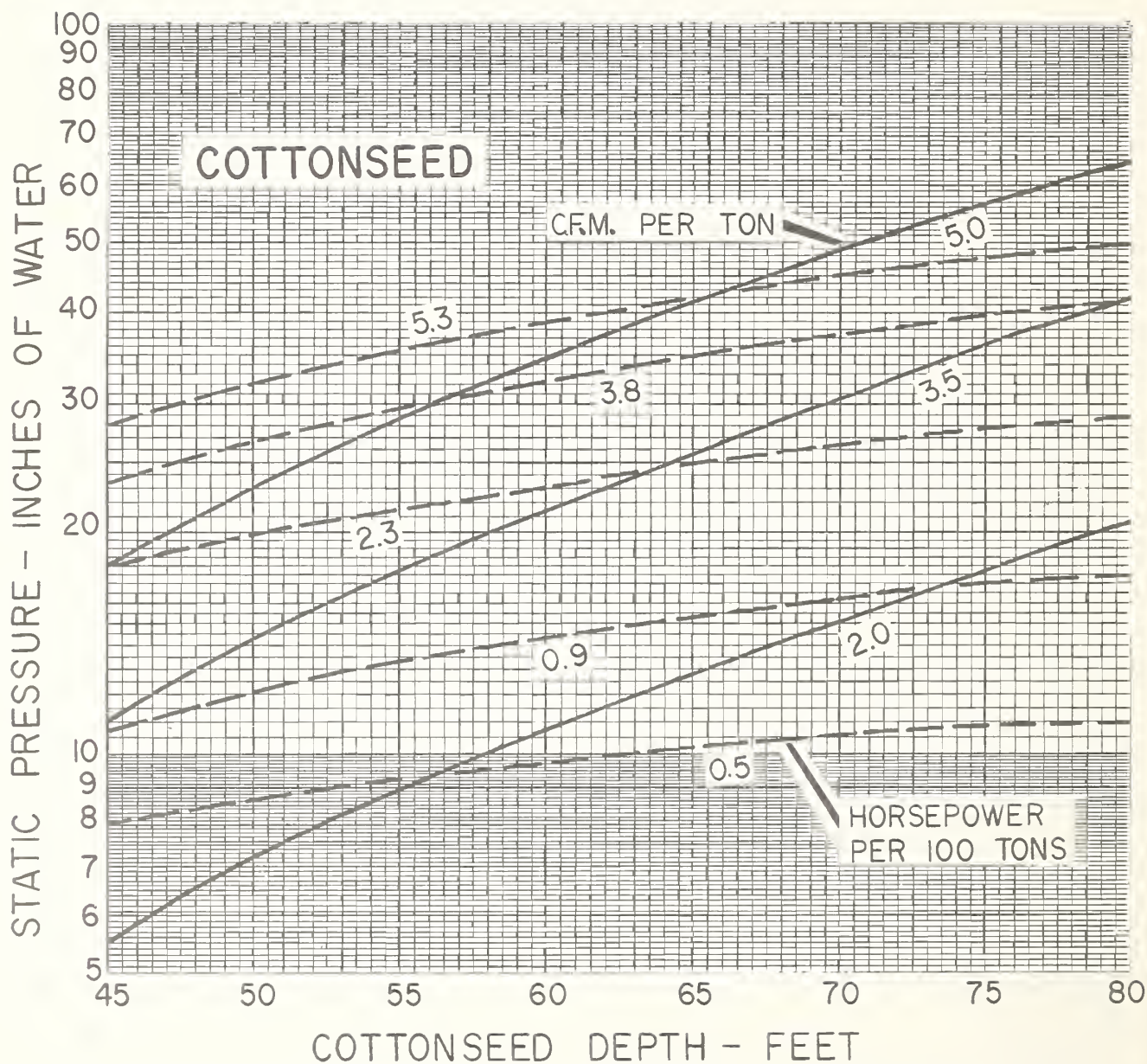


Figure 5. Fan horsepower and static pressure (inches of water) requirements for aerating cottonseed at different rates of airflow (c.f.m. per ton) and at cottonseed depths ranging from 45 to 80 feet

static pressure has now increased to 36.0 inches of water. The power requirement has also increased to approximately 3.5 horsepower per 100 tons of seed. As stated previously, this is an impractical airflow rate. A pressure type blower requiring tremendous power inputs would be necessary to overcome 36.0 inches of static pressure.

This paper presents some guidelines from our research work for designing aeration systems in commercial cottonseed storages. A more detailed published report should soon be available on the design, construction, installation, and operation of aeration systems for stored cottonseed.

PROSPECTS FOR SIGNIFICANT CHANGES IN OILSEED PROCESSING

by

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(NO PAPER AVAILABLE FOR PUBLICATION)

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